CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON State Mineralogist

San Francisco] BULLETIN No. 86 [July, 1919

CALIFORNIA MINERAL PRODUCTION FOR 1918

WITH COUNTY MAPS

BY

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CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1919

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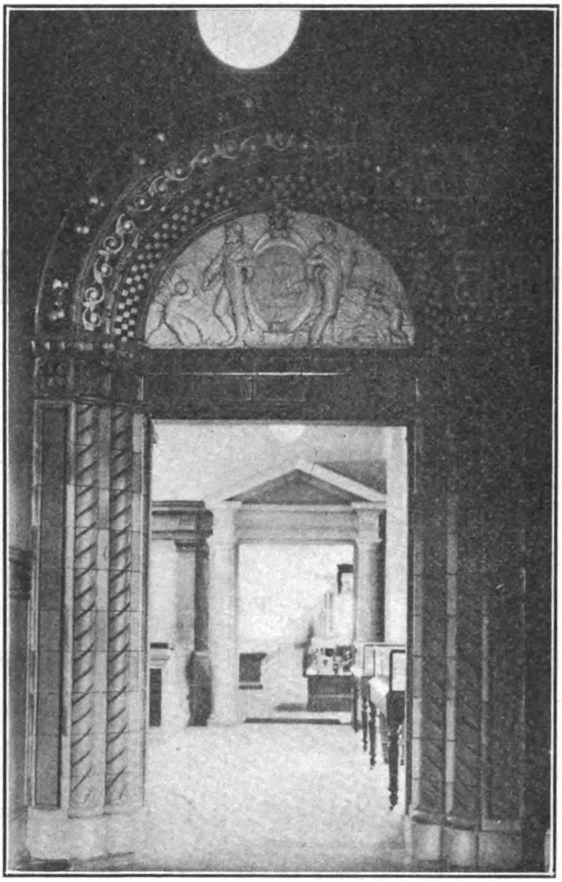

Exhibit of California structural materials in State Mining Bureau, Ferry Building, San Francisco.

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July, 1919.

To His Excellency, the Honorable WILLIAM D. STEPHENS,
Governor of the State of California.

SIR: I have the honor to herewith transmit Bulletin No. 86 of the State Mining Bureau, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's continued importance both in peace and in war, as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

FLETCHER HAMILTON,
State Mineralogist.

LETTER OF INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau, in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the co-operation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January has resulted in earlier completion of the manuscript this year; and it is hoped will further improve in the future.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

FLETCHER HAMILTON,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1918

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE MINING BUREAU, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA.

CHAPTER ONE.

Mineral output in California during the year 1918 amounted to the record sum of $199,753,837 worth of crudé materials. There were fifty-four different mineral substances, exclusive of a segregation of the various stones grouped under gems; and of the fifty-eight counties in the state, all but two contributed some mineral product.

As compared with the 1917 output, the notable features of 1918 are the enormous increase in petroleum valuation, and the decrease of over three million dollars in the gold yield. The result is a net increase in the grand total value of $38,550,875 over the 1917 total.

Of the metals: Copper decreased approximately 740,000 pounds in quantity and $1,444,000 in value. Gold decreased $3,558,342. Manganese increased in tonnage and value, and quicksilver slightly in value, while silver, lead, zinc and tungsten showed decreases.

Petroleum increased over four million barrels in quantity, and the prices per barrel for all grades continued to rise so materially that the net result was an increase of $40,483,012 in total value.

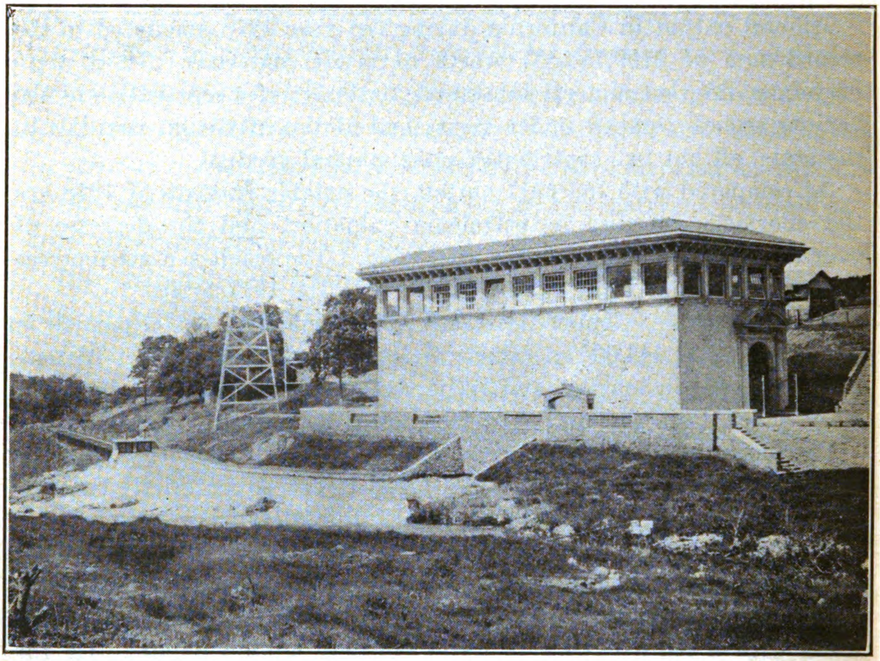
Decided changes are shown by some of the structural and industrial materials, among others, cement and chromite increasing, with magnesite and miscellaneous stone showing decreases. Of these, chromite leads with a gain of over two and one-half million dollars. Of the salines, potash increased over two and one-half millions in value, and borax decreased over a half million.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any other state in the United States, and probably more than any other equal area elsewhere of the earth. Previous to 1916, the total annual value of her output was surpassed by but four other states, they being the great coal and iron producers of east of the Mississippi River. In 1916 and 1917, because of their enormous increases in copper output, Montana and Arizona passed California in

total value for those years; and Arizona for 1918. Of one item, at least, borax, California still remains the sole producer; and for many years, was also the sole domestic source of chromite and magnesite. We produce at least 75% of the quicksilver of the United States. For some years we have been leading all others in gold and platinum; while alternating in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

Motor trucks have proven invaluable in opening up mineral properties hitherto an unprofitable distance from railroad transportation. The advent and improvement of motor vehicles has induced the build-



Wise Power House of the Pacific Gas and Electric Company near Auburn, Placer County. Hydroelectric power is an important item in the mining districts of California.

ing of better roads everywhere, thus assisting very greatly in the development of many of our natural resources. The coming year, 1919, will see a considerable increase in highway construction.

Hydroelectric power is an important item in the mining districts of the state. Reports in February and March, 1919, indicated a good fall of snow in the mountains, which will ensure a sufficient supply of water for the summer months.

The following table shows the comparative yield of mineral substances of California for 1917 and 1918, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

Substance	1917 Amount	1917 Value	1918 Amount	1918 Value	Increase+ Decrease— Value
Antimony ore	158 tons	$18,786			$18,786—
Asbestos	136 tons	10,225	229 tons	$9,903	322—
Barytes	4,420 tons	25,633	100 tons	1,500	24,133—
Bituminous rock	5,590 tons	18,580	2,561 tons	9,067	9,513—
Borax	109,944 tons	2,561,958	88,772 tons	1,867,908	694,050—
Brick and tile		2,532,721		2,363,481	169,240—
Cadmium	[1]	[1]	[3]	[3]	[3] +
Cement	5,790,734 bbls.	7,544,282	4,772,921 bbls.	7,969,909	425,627+
Chromite	52,379 tons	1,130,298	73,955 tons	3,649,497	2,519,199+
Clay (pottery)	166,298 tons	154,602	112,423 tons	166,788	12,186+
Coal	3,527 tons	7,691	6,343 tons	16,149	8,458+
Copper	48,534,611 lbs.	13,249,948	47,793,046 lbs.	11,805,883	1,444,065—
Dolomite	27,911 tons	66,416	24,560 tons	79,441	13,025+
Feldspar	11,792 tons	46,411	4,132 tons	22,061	24,350—
Fluorspar	[1]	[1]	[3]	[3]	[3] +
Fuller's earth	220 tons	2,180	37 tons	333	1,847—
Gems		3,049		650	2,399—
Gold		20,087,504		16,529,162	3,558,342—
Granite		221,997		139,861	82,136—
Graphite	[1]	[1]	[3]	[3]	[3] —
Gypsum	30,825 tons	56,840	19,695 tons	37,176	19,664—
Infusorial and diatomaceous earths	24,301 tons	127,510	35,963 tons	189,459	61,949+
Iron ore	2,874 tons	11,496	3,108 tons	15,947	4,451+
Lead	21,651,352 lbs.	1,862,016	13,464,869 lbs.	956,006	906,010—
Lime	500,730 bbls.	311,380	436,843 bbls.	461,315	149,935+
Limestone	237,279 tons	356,396	208,566 tons	456,258	99,862+
Lithia	880 tons	8,800	4,111 tons	73,998	65,198+
Magnesite	209,648 tons	1,976,227	83,974 tons	803,492	1,172,735—
Magnesium salts	1,064 tons	34,973	1,008 tons	29,955	5,018—
Manganese ore	15,515 tons	396,659	26,075 tons	979,235	582,576+
Marble	24,755 cu. ft.	62,950	[4]17,428 cu. ft.	49,898	13,052—
Mineral paint	520 tons	2,700	728 tons	4,738	2,038+
Mineral water	1,942,020 gals.	340,666	1,808,791 gals.	375,650	34,984+
Molybdenum	[1]	[1]	[3]	[3]	[3] —
Natural gas	44,343,020 M cu. ft.	2,964,922	46,373,052 M cu. ft.	3,289,524	324,602+
Petroleum	95,396,309 bbls.	86,976,209	99,731,177 bbls.	127,459,221	40,483,012+
Platinum	610 ounces	43,719	571 ounces	42,788	931—
Potash	129,022 tons	4,202,889	49,381 tons	6,808,976	2,606,087+
Pumice and volcanic ash	525 tons	5,295	2,114 tons	28,669	23,374+
Pyrite	111,325 tons	323,704	128,329 tons	425,012	101,308+
Quicksilver	24,382 flasks	2,396,466	22,621 flasks	2,579,472	183,006+
Salt	227,825 tons	584,373	212,076 tons	806,328	221,955+
Sandstone	31,090 cu. ft.	7,074	900 cu. ft.	400	6,674—
Serpentine	[1]	[1]	[5]	[5]	[5] —
Silica (sand and quartz)	19,376 tons	41,166	23,257 tons	88,930	47,764+
Silver		1,462,955		1,427,861	35,094—
Soapstone and talc	5,267 tons	45,279	11,760 tons	85,534	40,255+
Soda	24,505 tons	928,578	20,447 tons	855,423	73,155—
Stone, miscellaneous[2]		3,634,767		3,404,157	230,610—
Strontium	3,050 tons	37,000	2,900 tons	33,000	4,000—
Tungsten concentrates	2,466 tons	3,079,013	1,982 tons	2,832,222	246,791—
Zinc	11,854,804 lbs.	1,209,190	5,565,561 lbs.	506,466	702,724—
Unapportioned		[1]29,469		[3]15,134	14,335—
Totals		$161,202,962		$199,753,837	
Net increase					$38,550,875+

[1] Unapportioned—includes cadmium, fluorspar, graphite, molybdenum, and serpentine.

[2] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel and grinding mill pebbles.

[3] Unapportioned—includes cadmium, fluorspar, graphite and molybdenum.

[4] Includes onyx and serpentine.

[5] Combined with marble.

The following table shows the comparative value of the mineral production of the various counties in the state for the years 1917 and 1918:

County	1917	1918
Alameda	$1,138,723	$1,173,535
Alpine	----------	----------
Amador	3,851,194	3,452,640
Butte	1,130,259	873,035
Calaveras	3,717,150	2,794,452
Colusa	16,321	16,400
Contra Costa	1,276,657	1,324,251
Del Norte	104,340	371,675
El Dorado	313,602	959,286
Fresno	14,158,052	19,876,625
Glenn	65,272	89,699
Humboldt	59,858	141,954
Imperial	129,400	109,692
Inyo	6,296,230	5,177,676
Kern	49,743,422	63,410,685
Kings	2,777	9,229
Lake	170,552	215,876
Lassen	376	800
Los Angeles	8,204,523	16,006,628
Madera	236,937	114,327
Marin	272,302	176,183
Mariposa	352,227	352,504
Mendocino	50,415	108,388
Merced	147,116	74,849
Modoc	200	8,220
Mono	218,772	54,863
Monterey	138,786	119,687
Napa	1,421,073	1,676,367
Nevada	3,838,397	3,301,651
Orange	15,231,626	22,914,660
Placer	1,029,789	903,520
Plumas	2,294,886	3,092,694
Riverside	1,580,555	1,689,042
Sacramento	2,286,656	2,102,597
San Benito	1,233,163	1,537,463
San Bernardino	7,407,742	7,632,790
San Diego	1,713,708	1,942,150
San Francisco	107,957	16,463
San Joaquin	470,220	601,973
San Luis Obispo	338,144	858,679
San Mateo	207,163	193,812
Santa Barbara	5,153,081	10,051,831
Santa Clara	991,530	1,759,568
Santa Cruz	1,668,324	2,599,717
Shasta	10,244,869	8,098,671
Sierra	389,615	331,501
Siskiyou	829,409	877,287
Solano	1,899,231	1,470,726
Sonoma	506,750	586,391
Stanislaus	289,922	453,913
Sutter	5,000	----------
Tehama	44,019	157,591
Trinity	987,842	707,524
Tulare	1,499,988	527,408
Tuolumne	511,273	602,278
Ventura	1,498,010	2,186,311
Yolo	5,561	21,215
Yuba	3,721,996	3,844,885
Totals	$161,202,962	$199,753,837

Total Production.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper has also increased, beginning with 1897 following the entry of the Shasta County mines. Cement increased rapidly from 1902, while crushed rock, sand and gravel parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. Wartime increases, 1915-1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc.

Total Mineral Production of California by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18 761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,689,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
Totals	$799,879,382	$540,836,388	$668,228,926

Dividends.

Among the metal-mine dividend payers in 1918 in California the following have been reported:*

Company	Metal	Shares issued	Par value	Paid in 1919	Total	Latest dividends	
						Date	Amount
Argonaut	Gold	200,000	$5 00	$60,000	$1,950,000	Jan. 25, 1919	0.30
Atolia	Tungsten	100,000	1 00	---------	5,264,500	Sept. 15, 1918	0.50
Cerro Gordo	Lead, Zinc, Silver	975,000	1 00	---------	299,375	Jan. —, 1917	0.05
Engels	Copper	1,791,926	1 00	---------	565,273	Oct. 1, 1918	0.01½
First National	Copper	600,000	5 00	90,000	660,000	Mar. —, 1919	0.15
New Idria	Quicksilver	100,000	5 00	25,000	2,705,000	Jan. 1, 1919	0.25
North Star	Gold	250,000	10 00	100,000	5,537,040	June 28, 1919	0.40
Plymouth Con.	Gold	240,000	4 80	86,400	606,080	Jan. 1, 1919	0.12
Yukon Gold (also Alaska and Nevada)	Gold	3,500,000	5 00	---------	9,858,110	June —, 1918	0.02½

THE ECONOMIC LIMITS TO DOMESTIC INDEPENDENCE IN MINERALS.

Much has been written with respect to the effect of wartime demands on our various industries. Nowhere was this demand greater nor more vital than on our mineral resources. While many of the states, and California in particular, came forward in a splendid response, yet in certain specific cases occurrences within the boundaries of the United States are either lacking or totally deficient to meet our own needs.

This subject and that of the international phase of the utilization of mineral resources have been discussed by Smith[1] and Leith[2] recently. The writer deems it of sufficient value and interest to Californian mineral producers to quote from them, herein, somewhat at length:

"The war demands placed upon the United States created many new problems in connection with the supply of raw materials. Not only were former sources of supply cut off by the war's interference with commerce, but the large industrial expansion due to the world's larger need of American manufactured products caused in turn increased consumption of raw materials; the net result was an unprecedented and a too largely unexpected call upon the basal industries of the country—agriculture, forestry, and mining.

"Already the United States had become more nearly independent than any other industrial nation in the production of minerals; our output in 1913 was 36 per cent of the total for the world and included even larger percentages of the mineral fuels and copper, aluminum, zinc, and sulphur. Yet there were on the other side of the Nation's ledger notable deficiences in tin, platinum, nickel, manganese, chrome, potash, and nitrates, and the domestic supply of some of these minerals continues to be hopelessly inadequate. To meet the war demand for every mineral raw material was the larger task set before the mineral industry, and the degree of success attained and its cost are the basal facts in any inquiry as to the economic limits that must be recognized in developing the domestic supply.[3] * * *

"The war program, with its reaction upon industry, has opened the eyes of many to old facts. Mineral raw materials have won a recognition based upon the new realization of their value. De Launay's recent and apt characterization of coal

*Mining & Scientific Press, Vol. 119, p. 35, July 5, 1919.

[1]Smith, Geo. Otis, U. S. Geol. Surv.: Mineral Resources of the United States, 1917, Part I, pp. 1a-6a, 1918.

[2]Leith, C. K., idem. pp. 7a-16a.

[3]"The writer neither overlooks nor minimizes the international phase of the utilization of mineral resources, but because of the many-sided nature of the whole subject, the arrangement has been made for Prof. Leith to present the broader outlook in the paper which follows. It is hoped in this way to suggest more of the facts and principles that must be kept in mind by one who approaches the solution of this economic problem."

and iron as the two 'grand seigneurs' of the mineral world[4] is in strong contrast with the ancient idea of nobility among metals. The new measure of value is usefulness.

* * * * * * *

"In terms of commercial geology, therefore, ore deposits take on competitive relationships, and in terms of national interest there must be a determination of relative worth. The practical question concerns not simply the quantity of metal present in the ore but the quantity that can be won to the profit of mankind. First of all, then, in fixing the economic limits to the utilization of domestic mineral deposits, comes the balancing of cost of production with the value of the product. This requirement, which holds good in any business undertakings, however small, is none the less operative in an industry viewed in its national aspect. Economic profit is attained only by reducing cost or increasing value until the margin appears on the right side of the account.

"Into the cost of production enter the items of transportation, investment and labor. An industrial leader like Mr. Schwab[5] appreciates the 'handicap of distance,' although with a sportsman-like spirit he and other industrial leaders regard this handicap as simply another incentive to American ingenuity, not as a plea for preferential freight rates. The transportation factor has played a noteworthy part in every large production enterprise in the United States, where commonly mine and market are separated by hundreds if not thousands of miles.

"Improvement in transportation, whether interstate or international, tends to the equalization of opportunity: the peoples of the world are brought closer together. Artificial rates, however, in either interstate or international commerce will impose burdens rather than confer benefits, and we can not afford to throw back to the era of rebates. Therefore the facts of transportation must be written into the statement of production costs; the geologist and the engineer must from the start be geographers, for distance can not be eliminated from any commercial problem. The place factor enters so largely into the determination of value of mineral raw materials that many a promoter would gladly have the scientific investigator close his eyes to the facts regarding the accessibility of the deposit under examination. Yet the transportation cost is too often the cause of financial disaster, even when the geologic and other engineering facts have been correctly determined and are favorable to success.

"Investment and labor costs come less under the purview of the geologic engineer in his study of mineral resources, yet the power element is one that touches both of these items and is not to be overlooked by any student of industrial problems. It becomes more and more evident that the use of power, either steam or water, will become the deciding factor in American industry. The statistics of man power cited by Butler,[6] furnish the most convincing arguments as to the stability of our copper industry and its ability to dominate the world markets. The community of interest between some of the largest mining and power corporations is therefore to be regarded as a natural develpment along economic lines—not as an artifice in restraint of trade. Whether cheap power is made available for mine use by private initiative or by public control, the result is the same—cheap raw materials for other industries.

"During the war period the value of raw materials was in large part due to the emergency demand, and the experience should leave its realization of the exigency element in the determination of value. Under war conditions no one questions the great advantage of domestic independence in raw materials, and then adequate supply rather than low price is all-desirable. Nearness of source of raw materials is advantageous at other times, but the amount that can then be added to the value on that account is less easily determined. The purchasing agent of a large manufacturing plant may favor the near-by to the distant source of raw material and the domestic to the foreign producer as a matter of assurance that there will be no interruption to 'keeping the works running.' Yet the spirit of cost accounting leads usually to the cheapest market. Again it happens that when a productive industry so contributes to some larger business or group of industries as to be absolutely essential to their continuance this key industry takes on a larger significance than its size suggests.

"In the consideration of any domestic industry, the factor of home consumption must not be overlooked; indeed, home consumption is more directly connected with national welfare than exports. Our high per capita consumption of copper, for instance, means more to the nation than our exportable surplus of the same metal, the true value of which is indirect through the means it furnishes for trade or exchange for imports of other commodities for our own consumption. A nation that robs its domestic consumers so as to have an exportable surplus or to sell that surplus at a price below cost will be copying a German blunder in economics. Increased consumption of metals and mineral fuels means expansion of all industries, which in turn should mean a larger home market for all the things that go with a higher standard of living.

"The mineral control act of 1918 furnishes a too long delayed expression of the emergency value of mineral independence. The exigencies of war revealed many deficiencies in industrial preparedness, and *although over one-third of the world output in essential minerals was credited to the United States at the beginning of the war period, the largest part of the raw materials found to be inadequately supplied included minerals and their derivatives.*[7] Interruption to the importation of a relatively few ores brought immediate realization of the industrial advantages of a domestic supply, and the coincident shortage in rail transportation showed

[4]France—Allemagne, p. 225, 1917.
[5]American problems of reconstruction, p. 143, 1918.
[6]Butler, B. S., Copper: U. S. Geol Survey Mineral Resources, 1917, pt. 1, pp. —— (in preparation).
[7]The italics are ours.—W. W. B.

that the disadvantage of an international long haul differs only in degree from that of too long an interstate haul. The premium that industry can afford to pay for the assurance of an uninterrupted supply of raw material provides the answer to this question of the emergency value of either national or local independence.

"The proper valuation of national independence in raw materials therefore requires a careful weighing of the emergency factor, which introduces the insurance idea, as well as an estimating of future possibilities of lower costs as the industry develops. The incidental or the ultimate advantage may be so large as not to be seen by those who take too close a view of cost accounting or are shortsighted in their outlook on the nation's business. The old contradiction of penny-wise and pound-foolish holds true today in matters of cents and dollars.

"In every business there are elements of value that do not appear on the cost sheets. The war record of American business will not be complete except as it includes the story of those producers who kept up their output regardless of the losses involved—a type of patriotism not spectacular but exceedingly helpful. So, too, in time of peace there may be conditions under which, viewed in the larger way, it pays to do business at a loss.

"A composite diagram of either current output or future reserves of the essential minerals for the countries of the world would show so large a centralization in North America as to suggest that there is a group of nature-favored nations. This strategic advantage expresses itself in the well-recognized large degree of self-sufficiency of the United States, so that the question of economic limits to domestic independence concerns a relatively small number of minerals and makes our problem quite different from that in other and less favored nations. However, whether the debatable list includes only chromite, manganese, pyrite and potash, or is much longer, clear analysis of the economic problem is needed, for cost keeping on a national scale is the only safeguard against a loss which is real, even though not at once apparent.

"Whether wisest utilization of mineral resources means full utilization is debatable, and every student of natural resources realizes that the time of utilization is often an element in the degree of wisdom shown. It is not necessarily prodigal wastefulness that only the richest ore is mined when a new district is discovered; creation of transportation facilities, construction of smelters and mills, and general advance in technology are the intermediate steps between bonanza exploitation and the highly organized operation of low-grade deposits. Utah had a long history as a mining State and its contributions to the world's wealth were large before Bingham started a new epoch in copper mining. So, too, the reworking of dumps and of tailings ponds furnishes illustrations of the complete utilization that is evolved in these changing conditions, and the appreciation of this truth should warn us against too hasty, off-hand determination of the economic limitations placed by nature upon mining development. By the very nature of things many successful mining ventures are at the start unprofitable, and many ore deposits can be fully developed only through actual mining operation. In a national sense it may prove that 'nothing venture, nothing have.'

"The largest degree of national usefulness will be won from our mineral resources only through the highest industrial efficiency, which is in turn secured by engineering advance and the linking up of mechanical power and man power. This means to the end is typically American, but too much emphasis can not be put upon the importance of governmental action that is constructive in its co-operation with industry. While, unfortunately, public regulation seems to start usually with measures that are wholly restrictive in effect, because too often abuse of privilege has led to the legislative action, yet regulatory measures can be truly promotive, as has been shown in the recent co-operation of business and the Government. Public interest and private interest in the long run are less antagonistic than either the captain of industry or the public servant has suspected. It is true that the measure of economic worth must be the welfare of the individual, the community, and the people of the Nation, and not the dollar of profit to the corporation or the State, yet only a successful industry can be made to serve both owner and workman and the public as well. If the product is not actually worth its whole cost, no camouflage of bounty or tax exemption or import duty will long conceal the inherent weakness of the industry. The basic importance of the raw material resources to the country makes it a prime public duty of citizens generally to know the facts regarding the mineral industry, and to ascertain these facts the intensive study of our own resources is not enough: we must also acquire a comprehension of what minerals other countries contain to supplement what we have at home."

"INTERNATIONAL CONTROL OF MINERALS.[8]

"World Movement of Minerals.

"The annual world production of minerals approximates 1,700,000,000 tons, over 90 per cent of which consists of coal and iron. Of this amount about two-thirds is used within the countries where the minerals are produced and one-third is shipped to other countries. The mineral production of the United States amounts to about one-third of the total.

"In the discussion of mineral resources in their international aspects we are concerned primarily with the 33 per cent of the mineral output which moves between countries. It may be assumed that the consumption within the countries of origin is a matter of national rather than international concern.

"One of the several interesting facts in this world movement of minerals is that the movement of most of them shows a rather remarkable concentration. For instance, manganese moves from three principal sources and converges at four or

[8]Leith, C. K., op. cit.

five consuming centers. Chromite moves from two principal sources; tungsten also from two. Even for certain commodities which are widely distributed and move in large amounts the concentration of movement is rather marked—for instance, the world movement of coal is controlled by the United States, England, and Germany. In other words, although the world movement of mineral commodities is widespread and exhibits many complex features, most of the individual minerals follow two or three salient lines of movement. This means in general that for each mineral there are certain sources of limited geographic extent, which, because of location, grade, relation to transportation, cost—in short, all the factors that enter into availability—are drawn upon heavily for the world's chief demands. The convergence of these materials toward a few consuming centers indicates generally concentration of coal production necessary to smelting, high development of manufacturing, large per capita use, concentration of facilities, strong financial control, and, not least, a large element of enterprise which has taken advantage of more or less favorable conditions.

"Another significant fact which emphasizes the interdependence of nations and the importance of international considerations, is that no country is entirely self-sustaining in its mineral requirements.

* * * * * * *

"Changes Brought About by the War.

"The war wrought fundamental changes in the world movement of minerals. The character and distribution of the demands changed. Customary sources of supply were cut off. Financial disturbances and ship shortage profoundly modified the nature, distribution, and extent of the world movement. Our domestic mineral industry was abruptly brought to a realization of its vital relations with international trade. To illustrate, the large movement of manganese from India and Russia to the United States was abruptly stopped, and we had to develop a source of supply in Brazil. The stoppage of pyrite importations from Spain as a means of saving ships required the development of pyrite and sulphur supplies in the United States. The export of oil from the United States to European countries was greatly stimulated, and the export to other countries was correspondingly decreased. The world movements of coal were vitally affected, principally by the limitation of the coal shipments from England and the United States to South America and the concentration of shipments to European countries. The closing of German coal supplies to near-by countries had far-reaching consequences. The cutting off of the German potash left the world for the time being almost unsupplied with this vital fertilizing ingredient. The Chilean nitrates, on which the world had relied for fertilizer, were diverted almost exclusively to the manufacture of powder. The total annual imports of mineral commodities into the United States were reduced by 1,200,000 tons. Our exports, though they continued in large volume, were mainly concentrated in Europe. The story of these disturbances in the world movement of minerals, though highly interesting, is too long to be told here.

"International Control as a War Measure.

"Out of these sweeping and rapid changes in the world movement of mineral commodities there arose, partly as cause and partly as effect, international agreements for the allocation of minerals, as a means of insuring the proper proportions of supplies to the different countries for the most effective prosecution of the war. Inter-Allied purchasing committees in London and in Paris found it necessary to make an inter-Allied allocation of the output of Chilean nitrate, because the sum of the demands exceeded the total supply by a considerable fraction, and to agree on distribution and price of the world's supplies of tin, tungsten, and platinum. For many other commodities agreements of various sorts were made. For instance, the United States entered into an agreement with England and France for the purchase of iron ore and molybdenum from Scandinavia to keep it out of Germany. The United States and England agreed as to supplying Canada with ferromanganese. New problems of world allocation came up almost daily.

"Possibility of Post-War International Control.

"We now face the immediate and pressing question whether the centralized international control required by the war shall be retained or extended as a means of furthering the aims of a league of nations. When such a league was first proposed emphasis was placed mainly on political and military considerations. It now seems to be recognized that these are so closely interlocked with economic considerations that any league of nations, to be effective as a means of minimizing future international discord, must make provision for some degree of international or supernational control of business. Recent statements by officials of Great Britain and France seem to indicate a definite purpose to urge such control.

"Some of the reasons which have been urged for the international control of the movements of minerals are as follows:

1. To insure equitable distribution of certain minerals, such as tungsten, vanadium, platinum, and gold, of which there may be a world shortage.
2. To mitigate a world shortage of ships by international allocation of ship space, which would entail limitations on the movement of minerals.
3. To prevent nations which are more advantageously situated in regard to finance, location, and general control of trade from monopolizing the business in any commodity at the expense of other nations—in other words, to insure equality of opportunity in regard to basic raw materials. The control of many mineral commodities now approaches national monopoly.
4. To reach some agreement as to division of markets for commodities such as iron, steel, and coal, which are available in so great abundance that several of the larger nations have considerable exportable surplus, in order to prevent international difficulties due to unrestricted competition.
5. To maintain equilibrium of price.

6. To insure common and equitable contribution of supplies for rehabilitation of the devastated countries.
7. To serve as a means of disciplining any nation that will not conform to any code or control established by a league of nations. To many this has been a dominant consideration.
8. In general to prevent economic friction that might vitiate any world political agreements.
9. To replace the crude and cumbersome arrangements for international control through complex treaties and tariffs by a more centralized system.

"The foregoing is merely a list of suggestions that have been made; it is not a unit statement of the requirements of the situation.

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"Position of the United States in Regard to International Control of Minerals.

"The United States is more nearly self-sustaining in regard to mineral commodities as a whole than any other country on the globe. The following statement summarizes qualitatively our position:

"1. Minerals of which there is an adequate supply or exportable surplus in the United States:

A. Minerals of which our exportable surplus dominates the world situation:
Copper.
Petroleum.

B. Minerals of which our exportable surplus constitutes an important but not a dominant factor in the world trade:
Sulphur.
Phosphates.
Silver.
Iron and steel.
Coal.
Cement.
Uranium and radium.

C. Minerals of which our exportable surplus is not an important factor in world trade. Small amounts of most of these minerals have been and will doubtless continue to be imported because of special grades, backhaul, or cheaper sources of foreign supply, but these imports are for the most part incidental:
Lead.
Zinc.
Aluminum and bauxite.
Gold.
Tungsten.
Molybdenum.
Asphalt and bitumen.
Pyrite.
Barite.
Fluorspar.
Building stone (except Italian marble).
Cadmium.
Gypsum.
Lime.
Tripoli and diatomaceous earth.
Mineral paints (except umber, sienna, and ocher from France and Spain).
Pumice.
Garnet.
Salt (except special classes).
Talc.
Arsenic.
Bismuth.
Bromine.
Artificial abrasives, corundum, and emery (except Naxos emery).
Fuller's earth.
Mercury.

"2. Minerals for which the United States demand must continue to be met by imports:

A. Minerals for which the United States must depend almost entirely on other countries:
Tin.
Nickel.
Platinum and metals of the platinum group.

B. Minerals for which the United States will depend on foreign sources for a considerable fraction of the supply:
Antimony.
Vanadium.
Zirconium.
Mica.
Monazite.
Graphite.
Asbestos.
Ball clay and kaolin.
Chalk.
Cobalt.
Naxos emery.
Grinding pebbles.

"3. Minerals normally imported into the United States which in future can be largely produced from domestic sources if it seems desirable:

A. The following minerals were mainly imported before the war, but under war conditions the domestic resources have been developed to such an extent that the United States can become self-sustaining if desirable, though at so great a cost that a protective tariff will be necessary if these industries are to survive:

Nitrates (except potassium nitrates).
Potash.
Manganese.
Chromite.
Magnesite.

"No attempt will be made here to present the detailed figures on which the above generalizations are based. In view of the present disturbance in production and consumption, any judgment as to future demands or available surplus must take into account several factors which can not be accurately measured, such as financial control in foreign countries, possible tariffs, and foreign ompetition. For this reason the above statement should be regarded as only tentative, though it is the result of a rather exhaustive study of conditions in relation to the world control of shipping. The classes named overlap to some extent, and it is to be expected that some of the commodities placed in one class may in the near future be transferred to another.

"General Conclusions as to the International Control of Minerals from the Standpoint of the United States.

"1. It is clear that a league of nations offers but little advantage as a means of insuring adequate supplies for the United States, and that the limitations on the distribution of exportable mineral supplies would probably weigh more heavily on the United States than on any other country. The few minerals for which the United States is dependent on foreign countries are offset by so many in which we have a dominance of supply and our financial position is so strong that it appears certain that the United States does not need the aid of a league of nations to insure adequate supplies even of these few minerals. In short, in this respect our entrance into a league of nations would not be based on self-interest. We would sacrifice to some extent an independent and dominant position. In our dealings with other nations this fact should give weight to whatever emphasis the United States may wish to put on the desirability of international control of minerals. At the same time it imposes a hard task on the United States to arouse the mineral interests to the support of a measure that involves so much self-sacrifice. The value of our annual potential exportable surplus of minerals approximates a billion dollars; that of our necessary mineral imports about $175,000,000. Our active allies, Great Britain, France and Italy, together have a maximum annual exportable surplus worth perhaps $325,000,000, and their necessary imports amount to $265,000,000.

"2. It seems clear that our effort to make this country entirely self-sustaining in regard to raw materials, which has been especially marked during the war, will need to be modified if we are to adapt ourselves to conditions of international control. Although we may be able to become self-sustaining in respect to essential commodities like manganese, chromite, and potash, by so doing we are cutting off the export market of other countries where these commodities exist in such quantities and grades that they would be, under conditions of free trade, our principal sources of supply. By drawing on such sources we not only get a cheaper and higher grade of product, but we develop a return market for the products in respect to which our natural advantages entitle us to a share in the export trade. The potash situation will illustrate the problem: The war cut off German supplies. We made every possible effort to meet the deficiency. Prices rose tenfold. Now, are we to continue this effort at high cost? Our instinctive answer is, Yes. But suppose at the peace table it is mutually agreed that for the welfare of France and Spain we should absorb a certain part of their output, or even that we should take German potash as an indirect way of collecting indemnity? This question is put for the purpose of making the problem concrete, and no answer is attempted here, though I venture to suggest that the practicable course will be found to lie between the two extreme alternatives.

"If all countries take the stand that they must be self-sustaining in regard to natural resources, they can accomplish their purpose only by high artificial barriers to offset inequalities in the factors which determine the availability of the several commodities, with the result that the world movement of raw materials will be greatly lessened. Instead of free circulation of essential basic commodities vitalizing any world agreement there will be a series of compartments in which trade is maintained at different levels, under different pressures and conditions—a situation difficult to maintain and inimical to world agreements based on mutual concessions. It is clear that if each of the states of the United States should adopt the principle of making the state self-sustaining in minerals so far as possible, the result would be to increase largely the chances of interstate friction and to lower efficiency in the United States as a whole.

"3. * * * If the view expressed in conclusion 2 is correct, it follows that the United States, as a member of a league of nations, would not be free to impose tariffs dictated by national self-interest beyond such minor duties as might tend to equalize the labor element of cost of production. Also, when we remember the remarkable degree to which many of the leading mineral commodities are geographically concentrated, it is clear that a tariff on any particular commodity will usually affect mainly some one or two foreign nations—a result which does not accord with the principle that a state shall not give to one neighbor privileges that it withholds from others.

"More might be said for a temporary tariff designed to let down easily, for example, the manganese, chromite, and potash industries, which face large losses because of overdevelopment to meet war needs. The Mineral Act perhaps might be used for this purpose. If this principle were adopted for a few minerals, however, it probably would soon be extended to others and into more general nonmineral fields, thereby presenting a problem of enormous difficulty.

"In passing, it may be noted that as long as shipping is inadequate, as it may be for some years, high and slowly declining freight rates may serve much the same purpose as a tariff for low-priced commodities of much bulk, like manganese, though not for high-priced commodities like tungsten.

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"The question of protective tariffs is becoming acute at present, owing to the release of the restrictions imposed by the War Trade Board as a means of saving ships.

"4. The interests of conservation clearly call for an international viewpoint in the handling of our mineral resources. The deposits of most minerals are so highly concentrated in their distribution and general availability that the principal sources for the world are in comparatively few places. When all factors of conservation are taken into account, including labor and efficient use of the product, it would seem that the minerals should be drawn from these natural sources of supply. To illustrate, the chromite and manganese deposits of the United States are relatively small and of low grade as compared with other sources of supply. Insistence on the use of the domestic material would mean early exhaustion of local supplies, lowered efficiency in use, and higher cost. As cost includes not only the intrinsic value of a product, but items for labor and transportation, it appears that the use of these domestic materials means a higher expenditure of human effort than is necessary.

"There is perhaps as much need of specializing in mineral output as there is of specializing in manufacturing. The thought that every country on the globe should be self-sustaining in regard to mineral supplies is of somewhat the same order as the thought that every family should produce all its own raw materials rather than take advantage of the more favorable conditions existing elsewhere and so specialize in human effort. If for a certain amount of capital and labor we can produce copper more cheaply than any other country and thus dominate the world's markets, it is not economy to divert this capital and labor to the production of ores of manganese or chromite, which because of natural conditions can be produced much more cheaply elsewhere.

"5. * * * In a world governed by good will the effective internationalization of trade might well be gained by leaving trade unrestricted. In proportion as the actual condition may depart from this ideal condition, some sort of international agreement as to control seems justified. Such control would by no means eliminate international rivalries and jealousies; it would transfer them to the international governing body. The duties of such a body would be onerous and perplexing. It might even be supposed that nationalistic aspirations might be so strenuously presented and so firmly backed by national steps in the way of embargoes and protective tariffs that the international control would amount to little. But it may be further supposed that a league of nations whose members enter into it voluntarily and with mutual good faith might control the situation sufficiently to bring recalcitrant members into line. The questions thus suggested are difficult to answer.

"6. It is sometimes argued that any attempt to control the movement of raw materials, for whatever purpose, defeats itself because it leads to the automatic development in the restricted area of increased exploration, new sources of supply, substitutions, etc. Restriction unquestionably has this effect, but nevertheless such measures are expensive makeshifts and offset the effects of limitation only in part, as is clearly proved by the experiences of the war.

"7. The purpose of this paper is primarily to state the problem of international control of minerals, rather than to present an argument for it. Such control entails difficulties which are especially burdensome on the United States and which at present may be insuperable. The interests of conservation clearly require international control. Moreover, the lesson of the war points to the necessity of overhauling old international understandings and machinery, even though such a task would encounter great difficulties, not the least of which lie in the persistence of human habits and inertia. Whether the time has come to establish a league of nations with economic control can be determined only by our individual and collective answers to the question whether we are willing to make the necessary economic sacrifices, individually and nationally, in the interest of world harmony. The mineral industry should fully understand that with international control efforts to promote export will need to be modified and curtailed; that expansion of our trade in many lines will mean equivalent loss of trade to other nations; that the almost universal conception that expansion of foreign trade is a meritorious aim and end in itself, without regard to its effect on other countries, will need revision. * * *

"8. Whatever action may be taken in regard to international control, it is clear that the war has brought the United States into such world relations that it has become imperative for us to study and understand the world mineral situation much more comprehensively than before, in the interest not only of intelligent management of our own industries but of far-sighted handling of international relations."

CHAPTER TWO.

FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas and petroleum, the combined values of which make up over 50% of the state's entire mineral output.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer; but none has as yet been utilized for fuel.

Comparison of values during 1917 and 1918 is shown in the following table:

	1917		1918		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	3,527 tons	$7,691	6,343 tons	$16,149	$8,458+
Natural gas	44,343,020 M cu. ft.	2,964,922	46,373,052 M cu. ft.	3,289,524	324,602+
Petroleum	95,396,309 barrels	86,976,209	99,731,177 barrels	127,459,221	40,483,012+
Total value		$89,948,822		$130,764,894	
Net increase					$40,816,072+

COAL.

Bibliography: State Mineralogist Reports VII, XII, XIII, XIV, XV. U. S. G. S., Bulletins 285, 316, 431, 471, 581; An. Rep. 22, Pt. III.

Coal has been produced in California since as early as 1860, and until the development of crude oil was an important factor in the mineral industry of the state. As most of it is lignite, the quality is generally poor as compared with other coals on the Pacific Coast markets. However, in competition with fuel oil, coal of all grades has had to take second place. Besides the counties noted below as showing a commercial production, workable bodies of coal are also known in several others, including Alameda, Contra Costa, Mendocino, Shasta, Siskiyou and Riverside. Some coal has also been produced, in the past, in Fresno and Orange counties.


CALIFORNIA·STATE·MINING·BUREAU·
FLETCHER·HAMILTON·
·STATE·MINERALOGIST·
OUTLINE MAP
OF
CALIFORNIA
SCALE
SHOWING
LOCATIONS
OF
COAL DEPOSITS
1919
(ACCOMPANYING BULLETIN Nº 86)
O R E G O N
N E V A D A
P A C I F I C
O C E A N
M E X I C O
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
YUBA
NEVADA
SUTTER
PLACER
YOLO
EL DORADO
ALPINE
SONOMA
NAPA
SOLANO
SACRAMENTO
AMADOR
MARIN
CALAVERAS
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
CONTRA COSTA
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
FRESNO
INYO
SAN BENITO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
CRESCENT CITY
YREKA
ALTURAS
EUREKA
WEAVERVILLE
REDDING
SUSANVILLE
RED BLUFF
QUINCY
CHICO
DOWNIEVILLE
WILLOWS
OROVILLE
NEVADA CY.
UKIAH
LAKEPORT
MARYSVILLE
AUBURN
PLACERVILLE
MARKLEEVILLE
WOODLAND
SACRAMENTO
SANTA ROSA
NAPA
JACKSON
BRIDGEPORT
SAN ANDREAS
SAN RAFAEL
MARTINEZ
SONORA
STOCKTON
OAKLAND
MODESTO
REDWOOD CY.
SAN JOSE
MARIPOSA
MERCED
SANTA CRUZ
HOLLISTER
MADERA
INDEPENDENCE
SALINAS
FRESNO
VISALIA
HANFORD
COALINGA
TULARE LAKE
BAKERSFIELD
TAFT
SAN LUIS OBISPO
MOJAVE
BARSTOW
BAGGETT
LUDLOW
NEEDLES
SANTA BARBARA
VENTURA
SAN BERNARDINO
LOS ANGELES
RIVERSIDE
SANTA ANA
INDIO
SAN DIEGO
ELCENTRO

During 1918 production was reported from Amador and Monterey counties totaling 6,343 tons, worth $16,149. That from the Ione mine in Amador County was utilized for steaming and domestic purposes, mainly locally. That produced at the Stone Cañon property, Monterey County, was consumed at the mine in keeping the mine open and the pumps operating, none being shipped out during 1918.

Tests have been made by the U. S. Geological Survey[1] on some of the Ione lignite (because of its resemblance to some oil shales), to determine if it will yield oil on destructive distillation. Up to 62 gallons of oil per ton was obtained and also 18 pounds of ammonium sulphate as a by-product. The latter is valuable as a fertilizer. Analyses showed: 16% fixed carbon, 31% volatile matter, 46% moisture, 7% ash; and the heating value is 6,060 British thermal units.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later, the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1891	93,301	$204,902
1862	23,400	134,550	1892	85,178	209,711
1863	43,200	248,400	1893	72,603	167,555
1864	50,700	291,525	1894	59,887	139,862
1865	60,530	348,048	1895	79,858	193,790
1866	84,020	483,115	1896	70,649	161,335
1867	124,690	716,968	1897	87,449	196,255
1868	143,676	826,137	1898	143,045	337,475
1869	157,234	904,096	1899	160,941	420,109
1870	141,890	815,868	1900	176,956	535,531
1871	152,493	876,835	1901	150,724	401,772
1872	190,859	1,097,439	1902	88,460	248,622
1873	186,611	1,073,013	1903	93,026	265,383
1874	215,352	1,238,274	1904	79,062	376,494
1875	166,638	958,169	1905	46,500	144,500
1876	128,049	736,282	1906	24,850	61,600
1877	107,789	619,787	1907	23,731	55,849
1878	131,237	771,863	1908	18,496	55,503
1879	147,879	850,304	1909	49,389	216,913
1880	236,950	1,362,463	1910	11,033	23,484
1881	140,000	805,000	1911	11,047	18,297
1882	112,592	647,404	1912	14,484	39,092
1883	76,162	380,810	1913	25,198	85,809
1884	77,485	309,950	1914	11,859	28,806
1885	71,615	286,460	1915	10,299	26,662
1886	100,000	300,000	1916	4,037	7,030
1887	50,000	150,000	1917	3,527	7,691
1888	95,000	380,000	1918	6,343	16,149
1889	121,280	288,232			
1890	110,711	283,019	Totals	5,159,597	$22,868,257

The tonnage in the above table for the years 1861-1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93-94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

[1]U. S. Geol. Surv., Press Bulletin No. 402, March, 1919.

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields.

The figures here given are certainly far below the actual production, particularly in the six oil-producing counties. It is an exceptional oil property where gas in some quantity does not occur. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable. However, it is undoubtedly a fact that greater saving can frequently be made with profit. Gas traps of various size and design are coming into more frequent use. Some large operators are making commendable efforts to conserve the gas which accompanies oil and is richer than the so-called 'dry gas' occurring in strata which do not produce oil. As far as possible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The latest natural gas development (June, 1919) in California is the bringing in of two large dry-gas producers by the Standard Oil Company in the Elk Hills in western Kern County. One of these, 'No. 5,' was drilled to a certain stratum on the advice of the State Oil and Gas Supervisor, though the company officials were skeptical. It came in at an estimated flow of 30,000,000 cubic feet per 24 hours.

Several counties produce gas which is not accompanied by oil, particularly Sacramento and San Joaquin, where it is mixed with manufactured gas for domestic service.

The value of gas as here shown may be open to some question, but is certainly not too high, as regards the oil counties. The average price there is about 5¢-8¢ per 1,000 cubic feet. Approximately 7,000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4,000 cu. ft. per 24 hr. are consumed by a 25 h.p. engine, and 63,700 cu. ft. per day for heating a 70 h.p. steam boiler, which figures have been used in compiling this report.

Natural Gas, 1918.

County	M cubic feet	Value
Fresno	5,009,327	$267,123
Kern	23,545,128	1,507,912
Kings	2,460	590
Los Angeles	2,088,959	224,279
Orange	10,420,171	693,169
San Joaquin	202,453	60,405
Santa Barbara	4,150,316	338,036
Ventura	858,457	150,885
Butte, Humboldt, Lake, Sacramento, and Solano*	95,781	47,125
Totals	46,373,052	$3,289,524

*Combined to conceal output of an individual producer in each.

The annual production of natural gas in California since 1888 is as follows:

Year	Value	Year	Value
1888	$10,000	1905	$102,479
1889	12,680	1906	109,489
1890	33,000	1907	114,759
1891	30,000	1908	474,584
1892	55,000	1909	616,932
1893	68,500	1910	1,676,367
1894	79,072	1911	491,859
1895	112,000	1912	940,076
1896	111,457	1913	1,053,292
1897	62,657	1914	1,049,470
1898	74,424	1915	1,706,480
1899	95,000	1916	2,871,751
1900	34,578	1917	2,964,922
1901	92,034	1918	3,289,524
1902	99,443		
1903	74,237	Total	$18,597,101
1904	91,035		

Gasoline from Natural Gas.

As above indicated, more or less gas usually accompanies the petroleum in the oil fields. Approximately 50 plants are in operation manufacturing gasoline by compression or absorption from this 'casing-head gas.' After the gasoline is extracted, the remaining 'dry gas' is taken into the pipe lines, by which it is distributed to consumers, both domestic and commercial.

In the Midway field, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to transmission through the gas pipe lines. Some concerns market casing-head gasoline separately, while others turn it into the oil pipe lines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery, where it is later regained. A total of at least 20,900,400 gallons of casing-head gasoline from all fields was

made during 1918 and utilized directly as such. Kern County led in this output with a total of 8,594,878 gallons reported, Santa Barbara being second with 6,803,072 gallons.

The largest natural gas field of commercial importance thus far developed in California is in the Midway district, followed by Orange, Fresno, Santa Barbara, and Los Angeles counties. The Southern California Gas Company operates a 12-inch pipe line from the Midway field, a distance of 107 miles, to Los Angeles, where it supplies gas to local distributing companies. The Valley Natural Gas Company supplies gas to consumers in the Midway field and to local distributing companies at Fellows, Taft, Maricopa, Bakersfield, and the Kern River fields. The Santa Maria Gas and Power Company distributes gas around Santa Maria, from wells in the neighboring oil fields.

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84.

Chief of the fuels of California is petroleum. A complete description of the industry is to be found in Bulletin 69, issued in 1915 by the State Mining Bureau; supplemented by Bulletins 73, 82 and 84, annual reports of the Oil and Gas Supervisor, 1915-1918. The state law providing for the regulation of drilling and maintenance of oil and gas wells by the State Mining Bureau has been in effect since 1915. The chief aim is to protect the oil deposits from damage by water, and to aid producers in their work. A staff of technically trained men maintain offices in the various fields.

The oil production for California for 1918, as determined from the sworn statements made to the State Mineralogist for the Department of Petroleum and Gas, by the producers from 8,188 wells (exclusive of the Los Angeles City field) amounted to 99,459,177 barrels net. 'Net' means that a deduction of approximately 2% has been made for water. The oil consumed for fuel at the wells is this year included. This shows an increase of 5,025,630 barrels from the net figures for 1917. When the same deductions for water and fuel have been made from the figures already published by the Standard Oil Company and the Independent Oil Producers Agency, it will be seen that they are in fair agreement with the 99,459,177 barrels above recorded.

To the above amount, we have here added 272,000 barrels net output of the Los Angeles City field, making a total for the year 1918 of 99,731,177 barrels, valued at $127,459,221. Compared with 1917, this is an increase of 4,335,868 barrels in quantity, and of $40,483,012 in value. This great advance in value is due to the continued increase in

the average price per barrel for all fields and grades which began in 1916, as will be seen in one of the tables[1] following. The total or average figures on price may be open to some question, as it must be remembered that a large portion of the crude oil does not enter the open market, but is consumed or refined directly by the producers. The prices given are for oil which is actually sold, and are known to be accurate.

Features of 1918.

The principal features are: the decrease of approximately 4,000,000 barrels in the output of Kern County; and increases of 5,455,607 barrels in Los Angeles County, 1,702,541 barrels in Santa Barbara, 1,049,661 barrels in Orange, and 342,841 barrels in Ventura. Fresno County showed a slight decrease in quantity. That there was not a greater quantity increase is due to the marked falling off in drilling operations as compared with the year 1917. The records of the Department of Petroleum and Gas show an increase in the number of producing wells in 1917 over 1916 of 961, whereas 1918 increased only 354 wells over 1917. Were it not for the fortunate developments of the past two years in the new Montebello and Casmalia fields, the state would now be facing a serious decrease in production.

The decrease in Kern County is due in large part to the continued uncertainty resulting from the Federal suits. The failure of the Oil Land Leasing Bill of passage through Congress last winter was a great disappointment, even though the bill as drawn was not all that could have been desired, in justice, by the California operators concerned. The following is quoted from a recent press bulletin of the Department of Petroleum and Gas:[2]

"Figures compiled by McLaughlin some three years ago, but probably still approximately correct, showed title clouded, by withdrawals, on 19,745 acres of proved oil lands. The lands then contained 653 wells, representing an expenditure of nearly eighteen million dollars.

"The foregoing figures included 5,710 acres of proved land within Naval Reserve No. 2, containing 75 wells, representing a total expenditure of over three million dollars.

"The total oil production from the lands in question amounted, at the time of compilation, to 76,382,644 bbl., of which 18,068,600 bbls. had been taken from lands within the Naval Reserve.

"In Naval Reserve No. 1, in the Elk Hills, some 43 wells of various depths had been drilled at an expenditure of over a million and a quarter dollars. Little or no oil was produced from these wells.

"The question of settlement of titles to these lands, involving over one hundred claimants, has been pressed before Congress for about nine years. Unquestionably many operators, who spent money in entirely good faith, have been seriously injured by the delay. The reference in the report to 'fraudulent claims' indicates that the delay in handling just claims has, to no small extent, been caused by the insistence with which others have been presented."

California, as well as the Pacific Coast region generally, is vitally interested in the petroleum resources of the State. Wartime activity and subsequent efforts to readjust industrial conditions have recently brought the subject into prominence. The State Mining Bureau has

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[1]See page 31, *post*.
[2]Weekly Press Bulletin, No. 172, February 8, 1919.

for several years given particular attention to making a detailed inventory of the petroleum resources and of production methods.

Wasting Resources.

Public attention has been called to the fact that great and unjustifiable waste is going on. Such statements are occasionally discounted in some quarters on the ground that observations confined to a single state may be too limited. It is therefore interesting to note what attention has been given to the subject in a National way.

A bulletin published in November, 1918, by the United States National Museum at Washington, D. C., reviews the petroleum resources and the industry. Some of the striking statements are as follows:

"In the production of other raw materials there are no such conspicuous wastes as characterize the production of petroleum."

"By and large the situation in the United States is this: It costs a good deal to reach oil, but little or nothing to produce it. When reached, the oil must be produced as rapidly as possible, else someone else will get it. There is an unlimited demand for the crude product, with profit in such sale."

"In the case of continued laissez-faire (policy), we may expect to be confronted, some 15 or 20 years hence, with the discomforting realization that our domestic resource has been impoverished, a dependence upon a foreign country has developed, and the opportunity for betterment has passed—wasted. This is a simple matter of arithmetic, not an adventure in prophecy."

"The far west must either turn to coal, hauling much of it long distances, or else develop cheap electric energy from the streams of the Sierra and Coast ranges. It so happens, however, that over one-third of the water power of the country is to be found in the states of California, Oregon and Washington, ready to release oil from its crudest use as soon as adequate policy of national water-power administration comes into play."

Stability of the Oil Business.

The stability of the oil business in California is not as well recognized as the facts warrant. Popular misconception probably arises from the fact that the most hazardous feature of the business, that is, wildcatting or prospecting, is spectacular, makes excellent advertising copy, and therefore attracts widespread attention. It should be more generally understood that there is a large acreage of proved oil land in the state upon which operations are constantly carried on with fairly uniform financial results.

Figures compiled by State Oil and Gas Supervisor R. P. McLaughlin from publications and records of the State Mining Bureau show that during the last four years the acreage of proved oil land has increased by 23 per cent, or to a total of 89,212 acres. The number of producing wells has increased by 32% during the same period. There still remains a considerable margin of undrilled but proved oil land, as the 1918 figures indicate an average of 10.9 acres per producing well, whereas a figure of 8 acres would still be a safe average.

Remarkable uniformity of results is shown by comparison of the total market value of oil with the total amounts paid out as dividends. During the past 10 years the total market value of oil at the well has amounted to $563,933,888, while dividends have been paid by both producing and marketing concerns amounting to $204,551,564, or 36.3%

of the total value. The large amounts of oil produced and consumed directly by railroad companies enter into the figures for total market value, but do not appear with the dividends.

The total capitalization of all oil companies considered, for the year 1918, numbering 320, is $361,566,769, and the dividends in 1918 were at the rate of 7.6%. The capitalization of the smaller and purely producing companies is $161,425,494, and the 1918 dividend rate was 5.0%. The 1917 rates were 16.9% and 6.9% respectively. The added profits attending marketing and refining are therefore considerable.

The smaller companies which merely produce oil and sell it in a crude state, at the wells, have paid out $55,830,031 in dividends since 1909, which is 27.3% of the total dividends. These smaller companies at present produce about 28 per cent of the total oil, and own or control about 35 per cent of the proved acreage.

While it is true that the larger companies are constantly enlarging their holdings, by purchase from smaller concerns, there has also been a constant increase in the number of small companies paying dividends. In 1909 there were 65 such companies, and in 1918 there were 155.

Crude Oil Prices.

The average price of crude oil bears a fairly constant relation to the amounts paid out as dividends. From 1909 until 1918 inclusive, the average value of crude oil was 63.5¢ per barrel, while the total dividends have averaged about 23¢ per barrel of total production. Throughout that period prices have fluctuated between the limits of 48¢ and $1.28, but the total dividends have each year, except 1918, been at a rate of about 33¢ per barrel less than the average market price.

"The average prices, shown by statistics of past operations, are with difficulty compared with published quotations which vary with the gravity of oil, and are also subject to frequent change. However, the quotations of the Standard Oil Company for 24 gravity oil from the San Joaquin fields appear to have closely followed the average market price. It would, of course, be well to determine the factors which control the market quotations. Such a problem is complex, but it will be noted that during the past four years the quotations of the Standard Oil Company have reacted in a fairly uniform manner, and, inversely, with the amount of oil actually reported as in storage.

"The fact that the general public has not thoroughly recognized the stability of the California oil industry is no doubt due, to a very considerable extent, to the fact that many large operators have had too limited a view of the value of their own oil land assets. Men who have been successful in finding new oil fields frequently do not concern themselves with the later details of development. The idea has been too prevalent that profits must be quickly seized, regardless of the ultimate value of the property, and in many instances properties have been injured by careless operations. Some of the largest oil producers in the state have operated along such lines. This condition is clearly and definitely brought out by facts collected by the engineering staff of the State Mining Bureau during the past year in the testing of water shut-off at new wells. The average efficiency of the small concerns in this very important operation was 91 per cent while that of the large concerns was only 80 per cent. In fact only one large scale operator, the Shell Company of California, showed results equaling or excelling the average figure for the small companies; and one of the very largest producers, the Standard Oil Company, actually showed an efficiency of only 71 per cent.

Oil Land Ownership.

"One of the principal accomplishments of the State Mining Bureau during the past three years has been the introduction of up-to-date engineering methods into the operating organizations of many of the producing companies. Only two or three large companies still attempt to develop their lands by rule-of-thumb methods and empower their legal departments to resist the recommendations and regulations provided by the state law, which are based on careful engineering investigations.

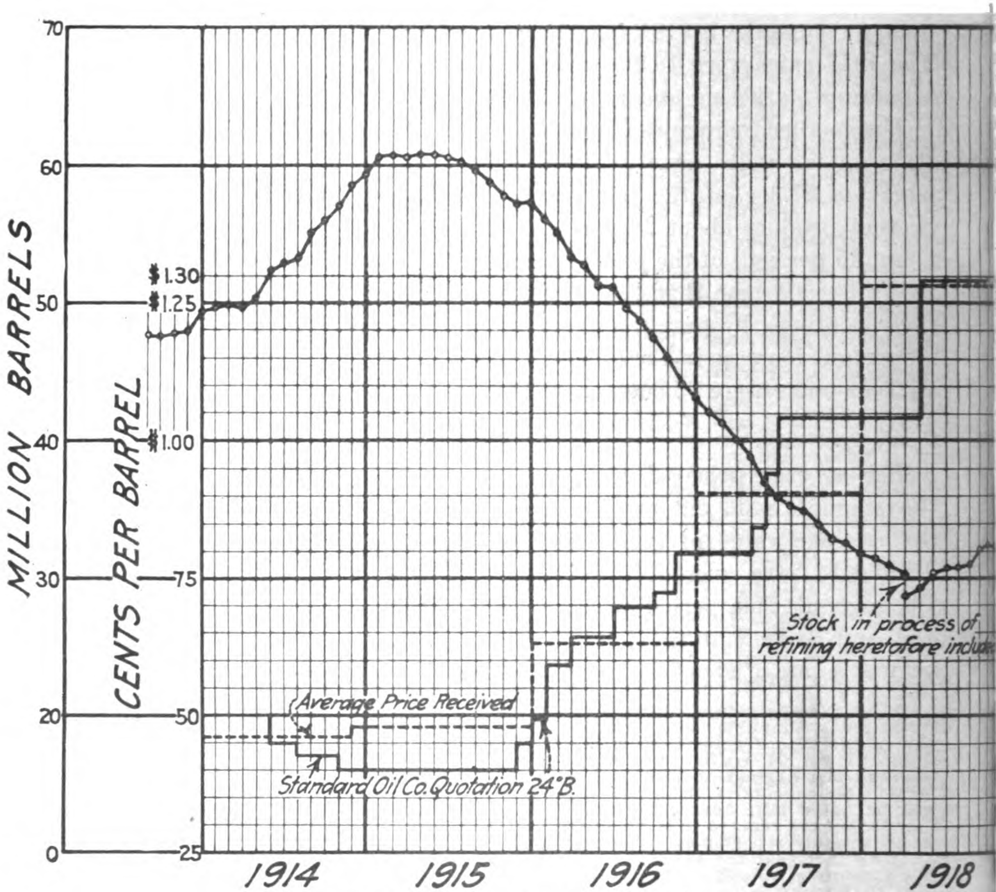


Chart Showing Relative Positions of
Average Price, 24° B. Quotations & Oil in Storage 1914-1918 (Inclusive)
Compiled by R. P. McLaughlin • CALIFORNIA STATE MINING BUREAU • Accompanying Bulletin No. 86

"A comparison of the present ownership of proved oil lands with that of four years ago still shows that there is no monopoly, although 65 per cent of the lands are held by only nine companies, and 72 per cent of the oil is produced by them. The land ownership and percentage of the total oil production by the larger concerns is shown in the following tabulation of the 1917 data:

Operator	Per cent of total oil	Proved land, acres	Number wells
Associated Oil Company	9.1	7,347	1.048
Doheny (various companies)	7.3	4.286	379
General Petroleum Corporation	4.3	2,584	400
Honolulu Consolidated Oil Company	1.3	2,701	35
Atchison, Topeka and Santa Fe Railway (oil subsidiaries)	4.0	3,097	412
Shell Company of California	6.8	2,442	236
Southern Pacific Company (fuel oil dept.)	8.5	18,267	681
Standard Oil Company	22.6	8,187	771
Union Oil Company of California	8.1	8,198	427
All others	28.0	30,171	3,381
Totals	100.0	87,280	7,770

"In the early part of the year, 1918, it will be remembered that there were frequent panicky and pessimistic statements relative to decreasing stocks of oil, together with various special pleas for the removal of various governmental regulations and restrictions. The State Mining Bureau each week regularly furnishes the public, through the newspapers, with complete statements of oil field activity, together with such general information as the facts justify. During the past year these statements have pointed out that production was increasing, or at least holding its own, in the face of decreased field activity, and that decrease of stored oil was due to increased industrial activity. There is not an unlimited supply of oil, and industrial demands for power can not always be met with oil."

Production Figures.

The following table gives the production by counties for 1918, compared with the 1917 figures:

Production and Value of Oil by Counties.

County	1917		1918	
	Barrels	Value	Barrels	Value
Fresno	16,259,797	$13,414,333	16,068,919	$19,138,083
Kern	53,065,066	47,387,104	49,049,917	61,410,496
Los Angeles	4,669,583	5,491,430	10,125,190	13,567,755
Orange	14,680,801	14,724,843	15,730,462	22,211,412
San Luis Obispo	74,143	68,656	62,744	56,783
Santa Barbara	5,631,563	4,550,303	7,334,104	9,057,618
Santa Clara	18,855	26,152	20,499	34,848
Ventura	996,501	1,313,388	1,339,342	1,982,226
Totals	95,396,309	$86,976,209	*99,731,177	$127,459,221

*See p. 26, *ante*.

Average Price of Oil, by Counties, in Cents per Barrel.

County	1914	1915	1916	1917	1918
Fresno	45.2¢	54.5¢	51.6¢	82.5¢	$1.191
Kern	40.9¢	42.3¢	64.1¢	89.3¢	1.252
Los Angeles	55.0¢	62.9¢	65.1¢	117.6¢	1.340
Orange	67.5¢	51.2¢	66.3¢	100.3¢	1.412
San Luis Obispo			45.0¢	92.6¢	0.905
Santa Barbara	46.0¢	61.1¢	79.4¢	80.8¢	1.235
Santa Clara	53.0¢	66.6¢	66.6¢	138.7¢	1.700
Ventura	105.0¢	85.5¢	104.5¢	131.8¢	1.480
State average	46.1¢	47.9¢	63.6¢	90.8¢	$1.278

The annual production since discovery in 1875 is as follows:

Year	Barrels	Year	Barrels
1875	175,000	1898	2,249,088
1876	12,000	1899	2,677,875
1877	13,000	1900	4,319,950
1878	15,227	1901	7,710,315
1879	19,858	1902	14,356,910
1880	40,552	1903	24,340,839
1881	99,862	1904	29,736,003
1882	128,636	1905	34,275,701
1883	142,857	1906	32,624,000
1884	262,000	1907	40,311,171
1885	325,000	1908	48,306,910
1886	377,145	1909	58,191,723
1887	678,572	1910	77,697,568
1888	690,333	1911	84,648,157
1889	303,220	1912	89,689,250
1890	307,360	1913	98,494,532
1891	323,600	1914	102,881,907
1892	385,049	1915	91,146,620
1893	470,179	1916	90,262,557
1894	783,078	1917	95,396,309
1895	1,245,339	1918	99,731,177
1896	1,257,780		
1897	1,911,569	Total	1,139,015,778

The total value since 1887 is as follows:

Year	Value
1887-1909	$136,693,228
1910	37,689,542
1911	40,552,088
1912	41,868,344
1913	48,578,014
1914	47,487,109
1915	43,503,837
1916	57,421,334
1917	86,976,209
1918	127,459,221
Total	$668,228,929

The following table shows the distribution by fields of the 1918 output, compared with 1917, as given by the Standard Oil Company:

Production by Fields.*
(In Barrels of 42 Gallons.)

Field	1917	1918
Kern River	8,495,610	7,921,515
McKittrick	3,252,544	3,050,627
Midway-Sunset	36,560,145	34,048,933
Lost Hills-Belridge	6,295,329	5,420,079
Coalinga	15,938,543	16,283,066
Lompoc and Santa Maria	5,798,070	7,143,750
Ventura County and Newhall	1,186,407	1,386,518
Los Angeles and Salt Lake	1,501,799	1,397,781
Whittier-Fullerton	18,155,440	24,903,613
Summerland	56,570	54,613
Watsonville	27,375	27,375
Totals	97,267,832	101,637,870
Net increase	----------	4,370,038

*Standard Oil Bulletin, January, 1919.

The following table is compiled from the monthly statements contained in the Standard Oil Bulletin:

Well Operations, by Fields, 1918.

Field	Producing December, 1917	Producing December, 1918	Completed	Abandoned
Kern River	1,969	1,996	30	--------
McKittrick	309	333	18	1
Midway-Sunset	1,997	2,208	220	10
Lost Hills-Belridge	485	535	47	3
Coalinga	1,038	1,140	105	24
Lompoc and Santa Maria	300	343	45	1
Ventura County and Newhall	451	456	33	3
Los Angeles and Salt Lake	683	664	--------	--------
Whittier-Fullerton	704	784	91	8
Summerland	112	142	--------	--------
Watsonville	5	5	--------	--------
Totals	8,053	8,606	589	50

The proportion of heavy and light oil produced in the various fields is shown by the following figures, for which we are indebted to the Standard Oil Company. Oil below 18° Baumé may be considered as largely unrefinable, or fuel oil; while the lighter oils yield varying amounts of refined products and a very large proportion of residuum and fuel oil. A few years ago, the total amount of heavy oil was in excess of the light oil.

Production of Light and Heavy Oil, by Fields, 1918.

Field	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	7,921,515	------------	7,921,515
McKittrick	3,050,627	------------	3,050,627
Midway-Sunset	10,176,262	23,872,671	34,048,933
Lost Hills-Belridge	1,676,888	3,743,191	5,420,079
Coalinga	5,658,799	10,624,267	16,283,066
Lompoc and Santa Maria	3,531,290	3,612,460	7,143,750
Ventura County and Newhall	91,508	1,295,010	1,386,518
Los Angeles and Salt Lake	1,158,800	238,981	1,397,781
Whittier-Fullerton	457,643	24,445,970	24,903,613
Summerland	54,613	------------	54,613
Watsonville	------------	27,375	27,375
Totals	33,777,945	67,859,925	101,637,870

In addition to consuming the current production of crude oil, the storage was drawn upon at an average rate of nearly 34,000 barrels per month during 1918. This is considerably less, however, than the 1917 rate of 1,000,000 barrels monthly. According to the Standard Oil Company[3] the stocks on hand December 31, 1918, amounted to 32,042,923 barrels, a decrease of 407,542 barrels from the 32,450,465 barrels on hand December 31, 1917.

Financial and Operating Condition of California Oil Fields, 1918.

Financial results of the oil business during 1918, are shown by the following tables. The outstanding features are: 1. the substantial increase of prices for all grades over the 1917 figures; 2. a decrease in most of the fields in the number of barrels per well per day yield; 3. an increase in operating costs per barrel, resulting in raising the cost per well per day.

Increases were registered in the number of barrels-per-well-per-day yield in Santa Barbara and Ventura counties, the former on account of new developments in the Casmalia field, and the latter from scattered new production in several small fields. The apparent decrease in the Los Angeles-Orange yield per-well-per-day is due to the fact that the 1917 figure is really a freak figure resulting from the initial gusher production in the Montebello field. The figures for the three years 1916-1918 inclusive: 15.9, 30.5, and 21.3, respectively—show that there is actually a net increase, the credit for which is due, of course, to the Montebello field.

Another interesting feature is that the Kern River field shows a fractional increase in the yield per-well-per-day, which means that that field is holding its own. This is no doubt in large part due to the corrective measures being taken in the systematic repairing of old wells against water encroachment, as indicated in a recent press bulletin[4]

[3]Standard Oil Bulletin, January, 1919.
[4]Weekly Press Bulletin No. 180, April 5, 1919.

of the Department of Petroleum and Gas of the State Mining Bureau. Portions of this field are among the worst water-flooded in the state. Systematic repair work was begun there in 1918, under the supervision of this department. Results following such repairs indicate that the production of oil can be nearly or quite doubled, if proper steps are taken to stop the flow of water; but this work can properly be pursued only after thorough engineering investigation of the underground conditions, covering not only the particular property involved but all neighboring properties.

The profitable, or dividend-paying companies received in the main a slightly higher figure for their product than the average market price, probably due to the higher grade of oil produced by them. It is also noticeable that their production cost per barrel is usually lower than the average, due to the fact that their wells are more productive. Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. There is nothing to indicate that unnatural causes or manipulations have affected the profits of one producer against another. It may be noted that both price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is being obtained from some of the Ventura County wells.

Capitalization.

Field	No. of companies considered*	Per cent of total product of field	Capital	
			Cash	Property
Coalinga	50	27	$4,574,916	$57,018,285
Kern River	49	45	5,623,533	7,915,208
Midway	73	43	8,632,473	27,564,481
Sunset	25		2,809,812	4,967,696
McKittrick, Lost Hills, Belridge	23	22	1,695,287	6,370,242
Santa Barbara County	16	28	964,943	8,759,335
Ventura County	23	77	1,071,364	7,249,939
Los Angeles and Orange counties	34	22	5,510,759	10,697,221
Subtotals	293	---------	$30,883,087	$130,542,407
Miscellaneous and marketing companies	27	42	108,438,785	91,702,490
Totals	320	---------	$139,321,872	$222,244,897

*See also table on p. 36.

Dividends Paid by Oil Companies, 1913-1918.

Field	1913 Com-panies	1913 Value	1914 Com-panies	1914 Value	1915 Com-panies	1915 Value	1916 Com-panies	1916 Value	1917 Com-panies	1917 Value	1918 Com-panies	1918 Value
Coalinga	17	$956,098	15	$1,048,840	13	$283,660	12	$217,949	20	$712,331	23	$1,055,600
Kern River	19	361,444	20	205,258	20	187,962	23	405,556	22	306,508	31	609,293
Midway	14	520,520	25	917,981	23	853,376	29	1,207,974	34	1,938,769	42	3,015,862
Sunset and Maricopa	3	91,936	5	166,152	7	149,932	5	241,200	14	682,644	15	638,926
McKittrick, Belridge and Lost Hills	6	538,744	8	493,339	7	397,827	7	434,184	14	837,129	12	708,984
Santa Barbara County	8	500,976	6	480,534	6	317,727	7	293,025	6	923,228	5	286,768
Ventura County	2	54,720	4	125,832	2	120,143	5	126,812	3	71,637	2	4,400
Los Angeles and Orange counties	14	3,015,159	13	2,453,981	14	863,677	12	1,222,598	16	3,079,447	14	1,201,021
Subtotals	83	$6,039,597	96	$5,891,917	92	$3,174,304	100	$4,149,298	129	$8,551,693	144	$7,520,854
Miscellaneous and marketing companies	8	9,509,009	9	9,384,308	13	9,926,044	13	*38,383,270	12	#40,981,214	11	19,984,138
Totals	91	$15,548,606	105	$15,276,225	105	$13,100,348	113	$42,532,568	141	$49,532,907	155	$27,504,992

*Includes a 50% stock dividend of the Standard Oil Company. #Includes a 33⅓% stock dividend of the Standard Oil Company.

Prices of Light and Heavy Oils, and Operating Data, 1918.

Field	Price: Under 18° Baume	Price: 18° and over	Price: Average price	Price: Price to dividend companies	Operating data, All companies considered*: Barrels per well per day yield	Operating data, All companies considered*: Operating cost per well day	Operating data, All companies considered*: Operating cost per barrel	Operating data, Dividend companies‡: Barrels per wall per day yield	Operating data, Dividend companies‡: Operating cost per well day	Operating data, Dividend companies‡: Operating cost per barrel
Coalinga	$1.145	$1.313	$1.191	$1.207	25.5	$10.07	$0.395	28.2	$10.63	$0.377
Kern River	1.101	----------	1.101	1.089	10.0	2.72	0.272	10.8	2.92	0.271
Midway	1.140	1.452	1.326	1.263	36.7	11.16	0.304	35.2	10.14	0.288
Sunset and Maricopa	1.085	1.130	1.109	1.098	34.6	8.55	0.247	37.9	8.64	0.228
McKittrick, Lost Hills and Belridge	1.048	1.362	1.227	1.184	22.6	6.94	0.307	24.3	7.05	0.290
Los Angeles and Orange counties	1.265	1.402	1.376	1.461	21.3	9,20	0.432	26.2	10.01	0.382
Santa Barbara County	0.838	1.428	1.235	1.483	46.6	13.61	0.29[illegible]	37.9	9.63	0.254
Ventura County	1.376	1.480	1.480	1.315	14.0	8.88	0.634	8.2	2.28	0.278

*See table on p. 35. ‡See table above.

It should be noted that in the case of a county like Ventura with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

Proved Oil Lands.

There were no additions of importance, during 1918, to the proved oil lands determined by the State Mining Bureau for the assessment of 1919. The total proved acreage is 89,212, showing an increase of 1,852 acres over the year 1918. Of this area, 57,499 acres are in Kern County alone. Fresno County is second on the list with 13,319 acres. Estimates of the total amount of oil which can be recovered from the land are little better than pure guesses but it does seem most probable that the average acre will ultimately yield much less than fifty thousand barrels.

The figures in detail are as follows:

Counties	Land (acres)	Wells (number)
Fresno	13,319	1,168
Kern	57,499	4,926
Los Angeles	2,873	783
Orange	3,530	504
San Luis Obispo	772	13
Santa Barbara	9,363	412
Santa Clara	80	8
Ventura	1,776	374

CHAPTER THREE.

METALS.

The total value of metals produced in California during 1918 was $37,686,072. The chief of these is, and always has been, gold, followed in order in 1918 by copper, tungsten, quicksilver, silver, manganese, lead, zinc, platinum, iron, cadmium and molybdenum. Deposits of ores of nickel and vanadium have also been found in the state, although there has as yet been no commercial output of them. There was no production of antimony in 1918.

California leads all states in the Union in her gold production, and the precious metal is widely distributed throughout the state. Thirty-three of the fifty-eight counties exported an output in 1918 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which is by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada foothill belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside, and San Diego counties.

Silver is not generally found alone in the state, but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California supplies approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress here.

A comparison of the 1918 metal output with that of 1917 is afforded by the following table:

Metal	1917		1918		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Antimony ore	158 tons	$18,786			$18,786—
Cadmium	*	*	*	*	* +
Copper	48,534,611 lbs.	13,249,948	47,793,046 lbs.	$11,805,883	1,444,065—
Gold		20,087,504		16,529,162	3,558,342—
Iron ore	2,874 tons	11,496	3,108 tons	15,947	4,451+
Lead	21,651,352 lbs.	1,862,016	13,464,869 lbs.	956,006	906,010—
Manganese ore	15,515 tons	396,659	26,075 tons	979,235	582,576+
Molybdenum ore	*	*	*	*	* —
Platinum	610 ounces	43,719	571 ounces	42,788	931—
Quicksilver	24,382 flasks	2,396,466	22,621 flasks	2,579,472	183,006+
Silver		1,462,955		1,427,861	35,094—
Tungsten concentrates	2,466 tons	3,079,013	1,982 tons	2,832,222	246,791—
Zinc	11,854,804 lbs.	1,209,190	5,565,561 lbs.	506,466	702,724—
Cadmium, molybdenum		18,857		11,030	7,827—
Totals		$43,836,609		$37,686,072	
Net decrease					$6,150,537—

*Combined to conceal output of a single operator in each.

ALUMINUM.

Bibliography: Bulletins 38, 67.

No workable deposits of bauxite have been discovered in the state, although from time to time small quantities of the impure material have been the foundation of extravagant reports regarding such discoveries.

ANTIMONY.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38.

Antimony is known to exist in a number of places in California, having been reported from Kern, Inyo, Nevada, Riverside, San Benito, and Santa Clara counties. The Kern County deposits, some of which carry the native metal, are possibly the best known, and efforts were made to work some of them before California was a part of the United States. The commonest occurrence is in the form of the sulphide, stibnite. No continuous production, however, has been maintained, the output for 1915 being the first reported since 1901, and there was none produced in 1918.

From the low point of 5.44¢ to 7.11¢ per pound, according to brand, in July, 1914, the price of antimony rose gradually, though not steadily, to 44¢ by the middle of January, 1916. American antimony, for the first time in many years, appeared on the market in competition with the Chinese and Japanese product. From $1.00 to $2.25 per unit was paid for ore, and at first a minimum of 50% accepted; but, later, some

lower grade ore was smelted. The price remained at 44¢ (San Francisco quotations) until the middle of April, 1916, then declined quite rapidly to 10¢ in August. It varied around 10¢ to 14¢ during most of 1917 and 1918. If the price drops below 12¢ per pound for the metal, few if any of the California mines can operate profitably.

During 1918 no antimony ore was reported sold.

The production of antimony by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1900	70	$5,700
1888	100	20,000	1901	50	8,350
1893	50	2,250	1915	510	35,666
1894	150	6,000	1916	1,015	64,793
1895	33	1,485	1917	158	18,786
1896	17	2,320	1918	--------	----------
1897	20	3,500			
1898	40	1,200	Totals	2,363	$199,050
1899	75	13,500			

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

In 1917, a few pounds of bismutospaerite (Bi_2CO_3) was reported taken out at the United Tungsten Copper mine, in the Morongo district, San Bernardino County. It is associated with scheelite in a contact deposit between limestone and granite.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted,[1] ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

CADMIUM.

In 1917, also in 1918, several thousand pounds of cadmium metal, in sticks, was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. The 1917 output was the first

[1]Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217-218.

commercial production of this metal recorded in California. As there was only the one producer, the exact figures and value are concealed under the 'unapportioned' item.

The cadmium occurs associated with the zinc sulphide, sphalerite, probably as the sulphide, greenockite. The principal uses of cadmium are in low melting-point, or cliché alloys, and in the manufacture of paint pigments. The cadmium alloys are said to be superior for some purposes to similar bismuth compounds. Cadmium is also used in bronze telegraph and telephone wires.

In the last year of the war (1918), the United States Government[2] and certain large concerns began experiments with cadmium solder as a means of saving tin. The results of these experiments were promising, but the demand for tin decreased, and the armistice was signed before cadmium solders became widely used. Cadmium was used by European nations during the war for some strictly military purposes, but little exact information is available to show those purposes. Germany was the first of the belligerent nations to make large use of cadmium as a substitute for tin in solders, being cut off by the blockade almost entirely from the world's sources of tin.

The average price for the metal and the sulphide of cadmium in 1918 was $1.48 and $1.36 per pound, respectively, compared with $1.47 and $1.41 in 1917.

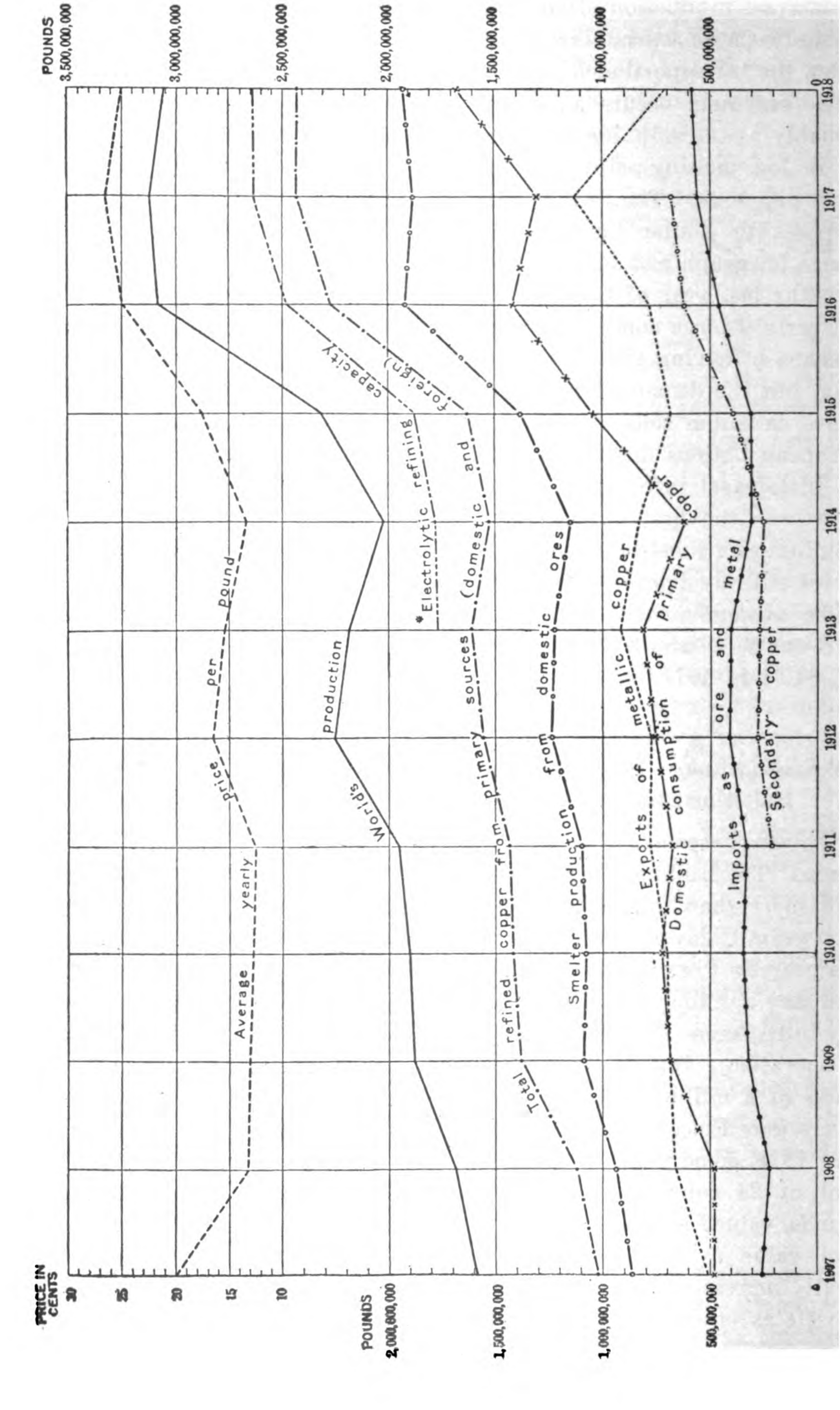
COPPER.

Bibliography: State Mineralogist Reports VII, XIII, XIV, XV. Bulletins 23, 50.

Copper is second only to gold, among the metals produced in California. The leading county in this metal is Shasta, with an output in 1918 more than double that of its nearest competitor, Plumas. For some years Calaveras County has been in second place, but was passed this year by Plumas due to the increased output of the Engels Copper Company and to an important contribution, also, from the Walker property in the same district. Both of these properties have flotation plants in operation. But one other county, San Bernardino, produced in excess of a million pounds of copper in 1918. Other important producers were Placer, Trinity, Siskiyou, Inyo, and Madera.

In 1918, some yield in greater or less amount, was reported from a total of 24 counties. The production for the year was 47,793,046 pounds, valued at $11,805,883, which is a decrease both in quantity and total value as compared with 1917. The European war caused a greatly increased demand for copper to make brass shells of all calibers, as well as other requirements. This raised the price from the 1914

[2]U. S. G. S. Press Bull. No. 407, May, 1919, p. 1.



* From Engineering and Mining Journal

Curves showing the principal features of the copper industry, 1907-1918. Figures for secondary copper for 1918 are not yet available.—From U. S. Geological Survey, Advance Statement, July, 1919.

average of 13.3¢ to 17.5¢ per pound in 1915; 24.6¢ in 1916; 27.3¢ in 1917, and 24.7¢ in 1918. On September 21, 1917, the U. S. Government fixed copper prices at 23.5¢ per lb. for large lots, and 24.67½¢ for small lots, effective until June 1, 1918.

Following the signing of the armistice in Europe, the price of copper dropped to 15¢ per pound, and a number of mines curtailed their operations or shut down entirely; since which the situation has gradually improved and the price has regained the 19¢ level (July, 1919).

Flotation concentration is now being successfully employed at a number of the copper mines in California, notably by the Engels Copper Company and the Walker Mine in Plumas County, the Calaveras Copper Company in Calaveras County, and the Mammoth Copper Company in Shasta County.

A leaching plant has been built near Raymond to handle ores from the Green Mountain copper mine in Mariposa County. It is proposed to place their product on the market in the form of bluestone, cement copper, and other by-products. The cement copper will be in a powdered form said to be in demand for use in marine paints.

Distribution of the output, by counties, for 1918, was as follows:

County	Pounds	Value
Calaveras	6,762,882	$1,670,432
El Dorado	22,259	5,498
Inyo	338,518	83,614
Kern	95,580	23,608
Madera	245,519	60,643
Mariposa	30,294	7,483
Mono	160	40
Nevada	42,203	10,424
Placer	837,527	206,869
Plumas	11,098,016	2,741,210
Riverside	19,485	4,813
San Bernardino	1,580,998	390,507
San Diego	4,143	1,023
Shasta	25,294,590	6,247,764
Siskiyou	573,593	141,677
Tuolumne	35,127	8,676
Amador, Contra Costa, Del Norte, Imperial, Marin, San Luis Obispo, Trinity, Yuba*	812,152	201,602
Totals	47,793,046	$11,805,883

*Combined to conceal output of a single operator in each.

Amount and value of copper production in California annually since such records have been compiled by the State Mining Bureau is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1887	1,600,000	$192,000	1904	29,974,154	$3,969,995
1888	1,570,021	235,303	1905	16,997,489	2,650,605
1889	151,505	18,180	1906	28,726,448	5,522,712
1890	23,347	3,502	1907	32,602,945	6,341,387
1891	3,397,455	424,675	1908	40,868,772	5,350,777
1892	2,980,944	342,808	1909	65,727,736	8,478,142
1893	239,682	21,571	1910	53,721,032	6,680,641
1894	738,594	72,486	1911	36,838,024	4,604,753
1895	225,650	21,901	1912	34,169,997	5,638,049
1896	1,992,844	199,519	1913	34,471,118	5,343,023
1897	13,638,626	1,540,666	1914	30,491,535	4,055,375
1898	21,543,229	2,475,168	1915	40,968,966	7,169,567
1899	23,915,486	3,990,534	1916	55,809,019	13,729,017
1900	29,515,512	4,748,242	1917	48,534,611	13,249,948
1901	34,931,788	5,501,782	1918	47,793,046	11,805,883
1902	27,860,162	3,239,975			
1903	19,113,861	2,520,997	Totals	781,133,598	$130,139,183

GOLD.

Bibliography: State Mineralogist Reports I to XV (inc.). Bulletins 36, 45, 57. U. S. G. S., Prof. Pap. 73.

Gold is one of the most important mineral products of California. For a number of years up to 1916 there was a marked tendency toward increased activity in gold mining, as investors realized that many of the mines and prospects have not been exhausted. The increase in costs of all supplies, labor and transportation during the past three years has made it increasingly difficult for the gold miner to operate at a profit. The gold output of not only California, but of the other western gold states has decreased greatly. Many of the mines were forced to close down.

During the war the gold miner was decidedly at a disadvantage. The prices of other metals and products could be raised to meet conditions; but the gold miner's dollar, being the base, had to remain at the same face value though its purchasing power had dropped to approximately 60%. A subsidy, and various other expedients were suggested. Government commissions, both in the United States and in England, investigated the situation, and arrived at similar conclusions—that gold must remain the basis of calculations, and must retain its present face value. Any changes of the base of valuations would have too far-reaching results. When conditions again assume a normal trend, gold mining will again increase; but it will doubtless take a year or two, at least.

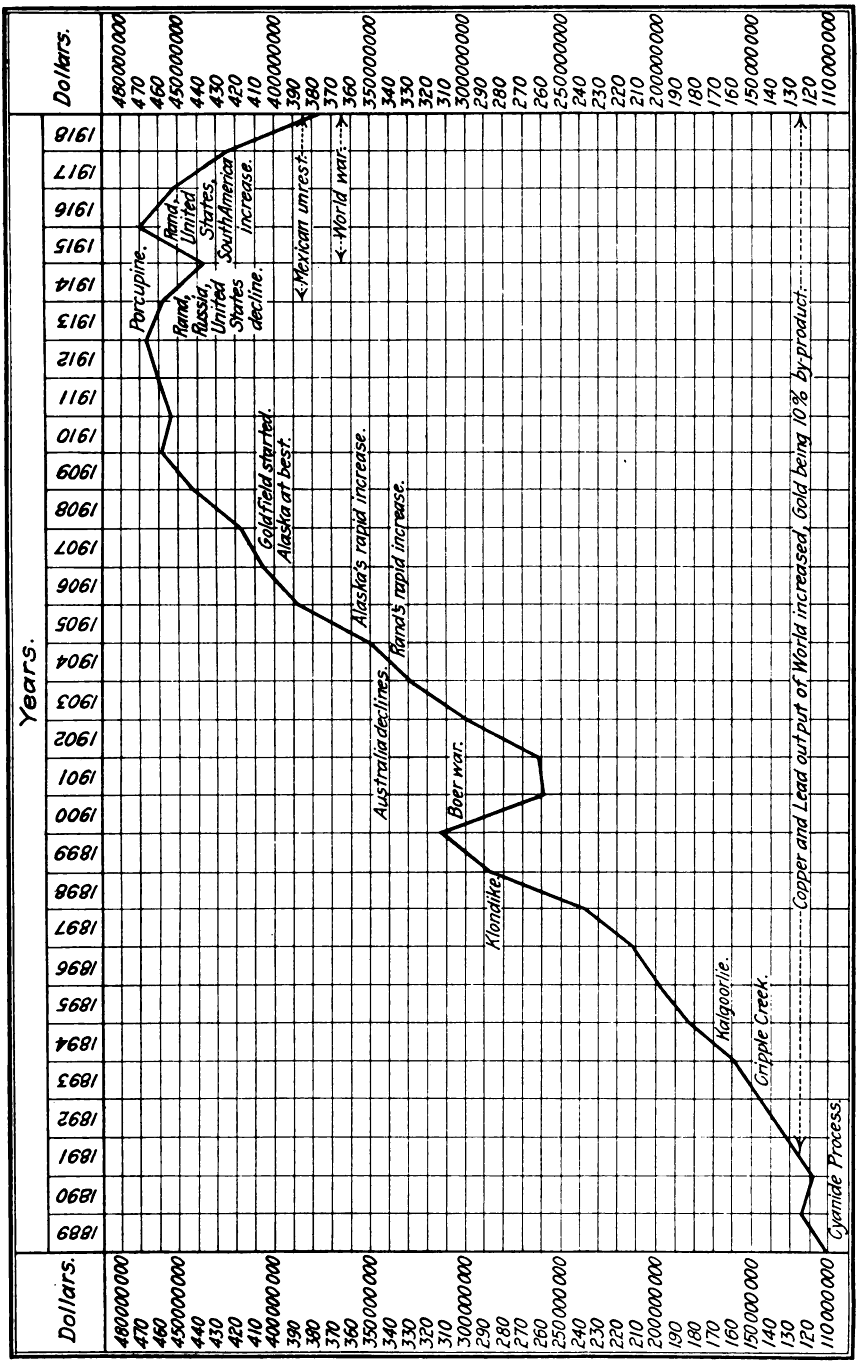


Chart Showing Gold Production of World For 30 Years.

Courtesy of the Mining and Scientific Press.

There is one branch of gold mining, however, that has apparently passed its zenith in California—that of dredging. The available ground at Oroville, in Butte County, the oldest field in the state, is nearly worked out. Some re-dredging will be done by larger, modern machines in the earliest ground worked there, but not over the entire area. In May, 1919, there remained but three boats in operation at Oroville.

The State Mining Bureau has never independently collected statistics of gold and silver production, as there is no necessity for duplicating the very thoroughly organized work of the U. S. Geological Survey covering those metals. The data here given relative to these two metals has been received through the courtesy and co-operation of Mr. Charles G. Yale, Statistician in Charge of the San Francisco branch office of the Division of Mineral Resources. Anyone wishing fuller details of the production of these metals may obtain the same by applying to the U. S. Geological Survey, Washington, D. C., or to room 305, U. S. Custom House, San Francisco, California, for a copy of the 'separate' on the subject.

"In considering the metal mining conditions in California for the year 1918, the outstanding feature to be noted is the unprecedented decrease in the gold production. For over 70 years the state has usually led all others of the Union in annual gold output, and its total production of the metal far exceeds all other states. But in 1918 all classes of mines producing gold show a very material reduction in output as compared with the year 1917. And not only is this decrease in values apparent in the gold-mining industry but it is in evidence in all classes of metal mining, which shows that the decline was entirely due to conditions brought about by the war and not to any decadence in gold mining alone.

"A careful study of the detailed returns, which came into the San Francisco office of the United States Geological Survey, reveals the fact that only to the extent of a few hundred thousand dollars has exhaustion of deposits influenced the decrease in gold yield. This exhaustion may be almost entirely attributed to the dredging interests and especially to two of the older extensive dredging fields and a few smaller 'outside' ones. Indeed, the largest and most extensive shows a material increase in yield, not sufficient, however, to overcome the loss in other fields. From the nature of the industry, working in surface deposits only, with definite areas as to boundaries, and predetermined average values to be obtained per cubic yard, there must be annually a certain exhaustion of the deposits, depending on the capacity of the gold-digging machinery. Moreover, it is but natural, on beginning work, as a matter of quick reimbursement of invested capital, the best ground has been first worked so that in older fields the machines are now digging on poorer ground than when they first began, resulting, of course, in smaller yield. A number of dredges have entirely worked out their available area of ground and ceased work altogether, or have been dismantled or moved to other districts where dredging ground is more circumscribed in area. In the smaller fields, outside of Yuba, Sacramento, and Butte counties, it does not pay to construct and operate the very large machines in use where there is abundant gravel on which to work, so the smaller ones, with less daily capacity, must necessarily have proportionately smaller production annually. The number of dredges operating, therefore, bears little relation to the total gold output, since one of the monster steel machines of recent construction in the Yuba County field will dig more gravel in a day than half a dozen or more of the small machines in other districts.

"The influence of the dredges on the gold-mining industry in California is paramount. This is evident from the fact that of the total gold produced in the state in 1918, 53 per cent came from the deep mines and 47 per cent from the placers, and of the total placer gold output the dredges produced 95 per cent and, indeed, 40 per cent of the entire gold of the state. The yield from deep mines was 2 per cent less of the total in 1918 than in 1917, and that from all placers, 2 per cent more, showing increased gains on the part of the gravel mines. It is worthy of note that the siliceous ore from the deep quartz gold mines produced 95 per cent of all the deep-mine gold, while the dredges produced exactly the same percentage of the total placer gold. The decrease in gold output of the deep mines in 1918, as compared with 1917, was $2,323,300, while the decrease in placer gold was $1,235,251, of which the dredge share was $881,600. So the deficit is much more largely due to deep than to placer mines. The leading gold-producing county of the state—Yuba—is almost entirely a gravel mining county, and in this county are more operating dredges and larger ones than in any other county of the state, and they produced nearly $100,000 more in 1918 than in 1917, yielding altogether 99 per cent of the total output of the county. This gravel mining county exceeded by $720,563 the output of deep gold of

Nevada County, which leads the deep-mine gold producers of the state. Amador County, second in rank in total gold yield in the state, only exceeded Nevada County in total gold yield, through the work of one dredge operating within its borders, everything else practically being from deep mines.

"The decrease in the production of gold in California in 1918 is very much more due to lessened output of the deep mines than to the placers. The production of the deep mines in 1918 decreased 20 per cent, whereas that of the placers decreased only 14 per cent. The number of distinctively deep-gold mines producing in 1918 was 260, which is 112 more than in 1917. The number of all kinds of deep mines, gold, copper, lead, etc., was 388 in 1918, or 147 more than in 1917, and from all of these more or less gold was obtained. It was almost entirely the war conditions which brought about this excessive deficit in the deep-mine gold industry. Very little loss is in evidence from exhaustion of ore deposits. Some deep mines ceased operations entirely during 1918 because the low grade of the ores could not meet expenses under existing conditions but will be able to resume work when affairs are more in a normal stage, and even those few which closed down permanently are more than overbalanced by new enterprises which began operations. The real cause of the reduction of gold output from deep mines was that these deep mines were not operated continuously through the year as usual, but temporarily ceased work and production for several months. Some of them were only worked for two, for three, or for six months, lying idle the rest of the time. Some worked steadily through the year with only one shift of men and all of them had to restrict operations, owing to lack of skilled labor. Even such labor as was available was inefficient, being mainly too-young or too-old men, and much loss was due to this condition. It must be remembered also that few of the larger deep gold producers were anxious to push production under costly conditions and pay resultant war income taxes. Their mines had to be kept in operation, but not necessarily up to capacity. Not only were labor costs excessive, but also those for supplies, power, freight, machinery, tools, etc., with the consequence that it cost very much more to produce an ounce of gold than it ever had before. Working deep mines, therefore, in many instances became almost prohibitory for much loss resulted if full operations were persisted in. In case of one of the very largest deep-gold mines in the state, with a gross output of $1,046,797, the president of the company in his annual report says, 'The conditions under which the business of gold mining was conducted during 1918 were so unfavorable and abnormal that the outcome affords no criterion of the results obtainable with ordinary factors of observation. The scarcity and inefficiency of labor and the high cost of all materials used, combined with a lower yield per ton crushed, resulted in a situation at the North Star mines during the latter part of the year when the cost of producing an ounce of gold exceeded the standard price at which it could be sold.' It may be explained in this instance that the scarcity of labor made it necessary to mine the ore most readily available, without proper sorting, in order to keep the mill supplied.

"The opinion thus expressed as to cost of production of an ounce of gold is concurred in by the superintendents of a number of other largely productive mines and the condition was even worse in smaller mines where costs are proportionately larger.

"In the five Mother Lode counties of the state, in one of which are the deepest gold mines, 60 per cent of the total ore milled in the state was treated. While the output of ore in these counties fell off largely in 1918, the average yield of the ore was about a dollar a ton higher than it has been in years and most of this ore came from very deep workings. This is a very encouraging feature indeed and refutes any idea of present exhaustion of ore bodies in the principal mines of the state. The value of all metals from ores of the state in 1918 gives an average of $9.32 per ton, as compared with $9.52 per ton in 1917. The ore milled and concentrated at gold and silver mills averaged $4.27 in gold and silver per ton, as compared with $4.46 per ton in 1917.

"It is a somewhat remarkable fact that under such adverse conditions in gold mining as existed in 1918, there should have been such a phenomenal increase in the number of mines reporting production, especially when it is considered that during the six preceding years there was a steady decrease in number annually. There were, altogether, 214 more mines reporting production in 1918 than in 1917, of which 147 were deep and 67 placers. It may be explained, however, that almost without exception the new producing properties are small mines, deep and placers, yielding from a few hundreds to a few thousands each. This was due to conditions in the mining regions of the state, in mountain, foothill, and valley counties, where old miners and prospetcors, and others without steady occupation and not capable for regular industrial or war work, turned to nomadic mining and prospecting in their respective localities. The gold was obtained in 'creviciing' in bedrock in the small gulches, and from the river beds along the rivers, gulches and creeks, working river sands and small gravel bars here and there where they found small spots yet unworked. Some gold is also obtained from small pocket seams and by 'sniping' at one place and another. Due to the fact, also, that no annual assessment work had been required on mining claims in war times, hundreds of mines laid idle and without caretakers or watchmen and many of these were gouged or gophered for small quantities of richer ore. Moreover, in many of these were a few tons more or less of sulphurets piled up to await larger shipments and these small lots were gathered, further concentrated perhaps, and shipped for treatment at smelters and local refining works. A great many prospectors were in the gold mining counties also, who gather up considerable gold while prospecting for permanent ledges or whatever then can find. Old partly abandoned mills and reduction works sometimes afforded comparatively rich pickings. The gold dust buyers, jewelers, and country banks and merchants buy the small lots thus obtained in various places and the sum total, when finally deposited at the mint, smelters, etc., amounts to a considerable sum.

"While the deep mines of the state suffered a decline in output for the reasons before mentioned, the placers themselves were generally hampered by a short water season in almost all parts of California, thus compelling them to cease washing gravel much earlier than usual and resulting in decreased output. Even the dredges

were more or less unfavorably influenced. They were unable to obtain help on the boats and then periods of work were shortened by power requirements. At times they were only allowed a small quantity of the electrical power needed for full-time work, the digging capacity of the boats being thus materially lessened."

* * * * * * *

"In 1918 there was treated at gold and silver mills and at concentrating plants 2,000,563 tons of ore yielding altogether $8,159,975 in gold and 385,208 fine ounces of silver, valued at $385,208, a total value of $8,545,183 in gold and silver, and an average value per ton of $4.27 in both metals. The average value in 1917 was $4.46; in 1916, $5.04; in 1915, $5.56; in 1914, $5.44; in 1913, $5.57; in 1912, $5.08; in 1911, $4.64; and in 1910, $5.25.

"There was recovered in 1918 as bullion in mills $6,098,104 in gold and 104,152 fine ounces of silver, valued at $104,152, a total of $6,202,256 in gold and silver, and an average per ton of $4.384 in both metals. From 1,414,644 tons of gold milling ore and 585,919 tons of concentrating ore, 92,191 tons of concentrates were obtained, containing $2,061,871 in gold and 281,056 fine ounces of silver, valued at $281,056. There was a yield of gold and silver of $2,342,927, or an average value of $25.41 a ton of concentrates.

"Of the smelting ores 448,523 tons were treated, having an output of gold of $451,863, and of 982,619 fine ounces of silver, valued at $982,619. The total yield of gold and silver was $1,434,482, or an average value of $3.20 a ton.

"There were treated also 35,177 tons of tailings and slags, yielding $78,336 in gold and 29,975 ounces of silver, valued at $29,975. The total gold and silver produced from tailings was $108,311, an average of about $3.08 a ton. This high average is due to the high grade of the slag treated from a few large mines."

* * * * * * *

"In 1918 there were 704 properties reporting production in California (214 more than in 1917), of which 388 were deep mines and 316 placers. The production of deep mines of 1918 may be classified by chief metallic product as follows: Gold, 260; copper, 62; lead, 56; copper-lead, 6; and zinc, 4. Of the placer mines 114 were surface or sluicing, 44 more than in 1917; 87 were hydraulic, 16 more than in 1917; 66 were drift, 13 more than in 1917; and 49 were dredges, 6 less than in 1917. Of the deep mines there were 112 more gold mines, 14 more copper, 13 more lead mines, 6 more copper-lead mines (none in 1917), and 2 more zinc; there were, therefore, 147 more deep mines producing in 1918 than in 1917. The dredges are enumerated by the number of boats at work, some companies operating only one and others several."

* * * * * * *

"The total production of gold in California in 1918 was 799,588.10 fine ounces, valued at $16,528,953, a decrease of 172,144.90 fine ounces, valued at $3,558,551. The deep mines of the state yielded 420,387.17 fine ounces of gold, valued at $8,690,174, which is a decrease of 112,389.63 fine ounces in quantity and of $2,323,300 in value. Of the deep-mine gold 95 per cent was derived from siliceous ore, 4 per cent from copper ore, and 1 per cent from lead ore.

"As shown above, there was a material decrease in the output of gold from deep mines in 1918, as compared with 1917. There was also a decrease in yield of placer mine gold of 59,755.27 fine ounces in quantity and of $1,235,251 in value. The dredges yielded $881,600 less gold in 1918 than in 1917. Since gold dredging began in California in 1898, the total tutput of gold from that source to the end of 1918 has been $102,618,912. Since 1898 the Oroville (Butte County) dredging field has yielded $30,687,986, not including $2,338,816 derived in the last 9 years from adjacent districts in the same county. The Marysville (Yuba County) field has produced from 1903 to 1918, inclusive, $31,869,100 in gold; the Folsom (Sacramento County) field has yielded since 1902 from dredging, gold valued at $23,525,954. The output of the dredges operating in numerous other fields in the state is not included in these figures of the more extended dredge fields. The placer yield of gold in 1918 in California was 379,200.93 fine ounces, valued at $7,838,779. The placer mines produced 47 per cent of the gold yield in 1918, and the deep mines 53 per cent, as compared with 45 per cent for the placers in 1917 and 55 per cent for the deep mines. The dredges produced 45 per cent of the total gold yield from all sources in 1918. Of the total placer gold, the dredges produced 95 per cent, the hydraulic mines 3 per cent, the drift mines 1 per cent, and the sluicing mines 1 per cent. It is probable that this percentage from surface placers is too high, for in the reports received at the office of the United States Geological Survey numbers of mines classify themselves as working placers without specifying the exact kind. Some of these may have been small hydraulic or drift mines instead of mere surface or sluicing mines. Although the larger and more important dredging fields of the state are at Oroville, in Butte County; Folsom, in Sacramento County; and Marysville, in Yuba County, dredges are also operated in 9 other counties—1 in Amador, 2 in Calaveras, 1 in Merced, 2 in Placer, 1 in San Joaquin, 4 in Shasta, 3 in Siskiyou, 1 in Stanislaus, and 4 in Trinity. The Yuba County dredges, 12 in number, made the largest output of gold in 1918, the value being $3,750,033, an increase of $90,822, compared with 1917. Sacramento County with 10 dredges at work made an output of $1,690,279, a decrease of $223,225 in gold output. In Butte County (including Oroville and the 'outside districts') 8 dredges produced $626,010, or $267,131 less than in 1917.

"Of the 32 counties producing gold in 1918 in California, 9 yielded no placer gold, and 6 yielded no gold from deep mines. Four counties produced more than $1,000,000 each in gold in 1918, as follows: Yuba, $3,767,933; Amador, $3,249,385; Nevada, $3,070,453; and Sacramento, $1,694.724. The leading hydraulic mining county was Trinity; the largest producer of gold from surface or sluicing placers was Butte; and the largest producer of gold from dredges was Yuba County. The largest increase—$90,260—in gold in 1918 was from Yuba County, which was followed by San Joaquin, $70,744 (there was none from this county in 1917), Mariposa, $24,386, and Modoc next. The counties which showed a decreased output of gold in 1918, as compared with 1917, were as follows: Nevada, $612,494; Calaveras, $600,179; Amador,

$414,779; Placer, $308,496; Kern, $291,725; Butte, $276,296; Shasta, $231,616; Sacramento, $224,857; Trinity, $157,319; San Bernardino, $127,757; Sierra, $95,060; Stanislaus, $66,519; Tuolumne, $46,757; Merced, $33,392; Siskiyou, $31,323; Inyo, $25,154; Humboldt, $15,058; Madera, $11,331; and Plumas, $6,748."

* * * * * * *

"From the siliceous ore and tailings the recovery of gold by methods of treatment in California in 1918 was as follows: By amalgamation, 283,293.08 fine ounces, valued at $5,856,188; by cyanidation, 46,289.60 fine ounces, valued at $956,891; by chlorination, 5,769.83 fine ounces, valued at $119,173; from concentrates sent to smelters for treatment, 65,564.90 fine ounces, valued at $1,355,347. These figures are only approximate, as many small operators keep no separate accounts and even the larger companies do not always segregate the quantity of gold obtained by separate systems of treatment. This is especially the case where larger mills amalgamate in the batteries and on the plates and pass the tailings and concentrates direct at once through the cyanide plants. The recovery of some of the gold is due to the use of the flotation system, but this has not been considered in the above segregation of methods of treatment of the ore.

"The 316 productive placer mines in California in 1918 yielded gold valued at $7,838,779, and 29,909 ounces of silver, valued at $29,909, a total of $7,868,688. The decrease in placer gold was $1,235,251 and the increase in value of silver was $7,449. In production of gold the dredge properties showed a decrease of $881,600, the hydraulic mines a decrease of $53,874; the drift mines a decrease of $258,339, and the surface or sluicing mines a decrease of $41,438."

The gold production of California for 1918 was distributed, by counties, as follows:

County	Value
Amador	$3,249,385
Butte	645,975
Calaveras	871,263
Del Norte	565
El Dorado	28,352
Fresno	4,795
Humboldt	8,028
Imperial	247
Inyo	100,240
Kern	246,127
Madera	7,583
Mariposa	337,682
Merced	41,089
Mono	31,252
Nevada	3,070,453
Placer	230,190
Plumas	125,207
Riverside	392
Sacramento	1,694,724
San Bernardino	29,225
Shasta	543,509
Sierra	289,368
Siskiyou	294,227
Stanislaus	114,196
Trinity	444,729
Tuolumne	274,328
Yuba	3,767,933
Marin, Mendocino, Modoc, Napa, San Joaquin, San Luis Obispo*	78,098
Total	$16,529,162

*Combined to conceal output of a single operator in each.

Total Gold Production of California.

The following table was compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips,

author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the diector of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures since 1904 are those prepared by the U. S. Geological Survey:

Year	Value	Year	Value
1848	$245,301	1884	$13,600,000
1849	10,151,360	1885	12,661,044
1850	41,273,106	1886	14,716,506
1851	75,938,232	1887	13,588,614
1852	81,294,700	1888	12,750,000
1853	67,613,487	1889	11,212,913
1854	69,433,931	1890	12,309,793
1855	55,485,395	1891	12,728,869
1856	57,509,411	1892	12,571,900
1857	43,628,172	1893	12,422,811
1858	46,591,140	1894	13,923,281
1859	45,846,599	1895	15,334,317
1860	44,095,163	1896	17,181,562
1861	41,884,995	1897	15,871,401
1862	38,854,668	1898	15,906,478
1863	23,501,736	1899	15,336,031
1864	24,071,423	1900	15,863,355
1865	17,930,858	1901	16,989,044
1866	17,123,867	1902	16,910,320
1867	18,265,452	1903	16,471,264
1868	17,555,867	1904	19,109,600
1869	18,229,044	1905	19,197,043
1870	17,458,133	1906	18,732,452
1871	17,477,885	1907	16,727,928
1872	15,482,194	1908	18,761,559
1873	15,019,210	1909	20,237,870
1874	17,264,836	1910	19,715,440
1875	16,876,009	1911	19,738,908
1876	15,610,723	1912	19,713,478
1877	16,501,268	1913	20,406,958
1878	18,839,141	1914	20,653,496
1879	19,626,654	1915	22,442,296
1880	20,030,761	1916	21,410,741
1881	19,223,155	1917	20,087,504
1882	17,146,416	1918	16,529,162
1883	24,316,873		
		Total	$1,689,211,103

IRIDIUM (See under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports II, IV, V, X, XII, XIII, XIV, XV. Bulletins 38, 67. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117-122.

Iron ore to the extent of 3,108 tons, valued at $15,947, was produced in San Bernardino and Shasta counties during the year 1918. It was utilized in the production of ferro-alloys by electric furnace reduction, and for foundry flux.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited, on account of our having no economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction. Further developments along the line of electrical smelting, or discoveries making available our petroleum fuel, for iron reduction, would lead to considerable increase of iron mining in California. For the present, at least, the most feasible possibilities lie in utilizing our iron resources in the preparation of the various alloys such as ferrochrome, ferro-manganese, ferro-molybdenum, ferro-silicon and ferrotungsten, by means of the electric furnace. California possesses commercial deposits and is producing ores of all of the metals just enumerated. In addition to two electric smelting units in operation during 1918, one blast furnace unit was also working in Shasta County.

During 1918, the Noble Electric Steel Company had two electric furnaces at Heroult, Shasta County, in operation, as well as a blast furnace unit; and the Pacific Electro Metals Company made ferromanganese with an electric furnace at their plant at Bay Point, Contra Costa County.

Total iron ore production in the state, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1909	108	$174
1882	2,073	17,766	1910	579	900
1883	11,191	106,540	1911	558	558
1884	4,532	40,983	1912	2,508	2,508
1885	----------	----------	1913	2,343	4,485
1886	3,676	19,250	1914	1,436	5,128
1887	----------	----------	1915	724	2,584
1893	250	2,000	1916	3,000	6,000
1894	200	1,500	1917	2,874	11,496
1895	----------	----------	1918	3,108	15,947
1907	400	400			
1908	----------	----------	Totals	48,833	$317,671

*Productions for the years 1881-1886 (inc.) were reported as "tons of pig iron," (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist's Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

LEAD.

Bibliography: State Mineralogist Reports IV, VIII, X, XV.

Lead production in California in 1918 fell off to a little over half that of the preceding year, both in quantity and value. The average price dropped from 8.6¢ in 1917 to 7.1¢ per pound in 1918; which, however, is still considerably above the pre-war prices of 3.9¢ in 1914 and 4.7¢ in 1915.

The principal production in this state comes from Inyo County, which contributed 91% of the 1918 yield, followed by San Bernardino and Shasta in the order named.

County returns for 1918, showing amounts and values, were:

County	Pounds	Value
Inyo	12,223,471	$867,866
Mono	1,318	94
San Bernardino	667,978	47,426
Shasta	492,565	34,972
Calaveras, Imperial, Kern, Mariposa, Nevada, Riverside, Siskiyou*	79,537	5,648
Totals	13,464,869	$956,006

*Combined to conceal output of a single operator in each.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	580	$52,200	1904	62	$5,270
1888	450	38,250	1905	266	25,083
1889	470	35,720	1906	169	19,307
1890	400	36,000	1907	164	16,690
1891	570	49,020	1908	562	46,663
1892	680	54,400	1909	1,343	144,897
1893	333	24,975	1910	1,508	134,082
1894	475	28,500	1911	701	63,173
1895	796	49,364	1912	685	61,653
1896	646	38,805	1913	1,820	160,202
1897	298	20,264	1914	2,349	183,198
1898	328	23,907	1915	2,398	225,426
1899	360	30,642	1916	6,196	855,049
1900	520	41,600	1917	10,826	1,862,016
1901	360	28,820	1918	6,732	956,006
1902	175	12,230			
1903	55	3,960	Totals	43,277	$5,327,372

MANGANESE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletins 38, 67, 76. U. S. G. S., Bull. 427.

In the statistical reports previous to 1915, manganese ore was included in the 'industrial materials' list. In that year we made a transfer, and have since placed it under 'metals,' because by far the greater tonnage of manganese ore is utilized in the preparation of ferro-manganese and employed in the steel industry both for its metal content and to slag off certain impurities during the open-hearth treatment. Though its other uses may be classed as 'chemical,' the tonnage thus consumed is relatively smaller. Its chemical uses are as a decolorizer or oxidizer in glass manufacture, and as a constituent in electric dry batteries. The chemical uses require a much higher grade of ore than the steel industry. For steel purposes, an iron content is acceptable, but manganese should exceed 40%. Silicia should be under 8%, though higher has been taken during the recent increased demand. Phosphorus should be under 0.20%. For electric dry cells, the iron content should be under 1.5% Fe_2O_3, and SiO_2, under 6%. For glassmaking the manganese should be practically free of iron. On account of the high prices prevailing for manganese during the past two years, it is stated that selenium was replacing it, in part at least, in glass factories.

The following schedule of prices for domestic ore was arranged by the American Iron and Steel Institute, and approved by the War Industries Board, effective from May 28, 1918, until the market broke following the signing of the armistice in November:

"Prices are per unit of metallic manganese per long ton (2240 lb.), for ore mined and shipped from all points west of South Chicago, Illinois. The prices are on basis of delivery, f.o.b. cars South Chicago. When shipped to other destinations than Chicago, the freight-rate per gross ton from shipping point to South Chicago is to be deducted to give the price f.o.b. shipping point. For ore shipped to points east of Chicago, 15c per unit is to be added to the schedule given below. Chemical ores are not included. Prices are based on ore dried at 212° F.

Mn, %	Per unit	Mn, %	Per unit
35 to 35.99	$0.86	45 to 45.99	$1.12
36 to 36.99	0.90	46 to 46.99	1.14
37 to 37.99	0.94	47 to 47.99	1.16
38 to 38.99	0.98	48 to 48.99	1.18
39 to 39.99	1.00	49 to 49.99	1.20
40 to 40.99	1.02	50 to 50.99	1.22
41 to 41.99	1.04	51 to 51.99	1.24
42 to 42.99	1.06	52 to 52.99	1.26
43 to 43.99	1.08	53 to 53.99	1.28
44 to 44.99	1.10	54 and over	1.30

"These prices are net to producer, buyers to pay salary or commission of their agents. In payment, 80% of estimated value of the ore (less moisture and freight from shipping point) to be paid against railroad bill-of-lading, with attached analysis, balance on receipt of ore by buyer.

"The above prices are based on ore carrying not over 8% silica and 0.25% phosphorus. Bonuses and penalties are as under:

Bonuses.		Penalties.	
SiO_2, %	Per ton	SiO_2, %	Per ton
Each 1% between 8 and 5%	$0.50	Each 1% from 8 to 15%	$0.50
Each 1% under 5%	1.00	Each 1% from 15 to 20%	0.75
		Each 1% from 20 to 25%	1.00

"For each 0.01% in excess of 0.25% phosphorus there is a penalty against unit price paid for manganese of ½% per unit figured to fractions."

Though the imports of manganese ore from the Caucasus district in Russia were reduced by the war to practically nothing (about 1% of 1914 figures), the United States received important shipments from Brazil, India and Cuba; so that the total imports for 1916 were practically double those of either 1914 or 1915. The 1916 figures were 576,321 long tons, valued at $8,666,179; for 1917, a total of 629,972 long tons, valued at $10,262,929, of which 512,517 tons were from Brazil; and in 1918 a total of 491,303 long tons, valued at $15,095,867, of which 345,877 tons were from Brazil. The increased demand for steel products increased the necessity for ferro-manganese, which is used largely in the open-hearth process of steel making. This resulted in curtailment of ferro-manganese exports from England, and the resulting shortage in the United States was met by the greater imports of manganese ore from Brazil especially, and an increased domestic production both of ore and ferro-manganese. These conditions caused the prices for the ores to range from $30-$60 per ton, f.o.b. rail, California, for the steel grades, to above $75 for chemical grades.

Reports received by the Survey[1] from makers of manganese alloys—ferro-manganese and spiegeleisen—

"indicate that 35 per cent of the metallic manganese used in the alloys made and imported during 1918 was derived from ores mined in the United States. As the proportion of domestic manganese in such alloys was only 4 per cent in 1913 and 16 per cent in 1916 the domestic miners of manganese made a notable contribution to the nation's independence in mineral supplies in war time. Had the war continued for another year domestic ores would probably have supplied half the manganese in the manganese alloys needed by the country."

Batteries, chemicals, and kindred industries in the United States consume approximately 25,000 tons of high-grade manganese ore, annually, or about one-thirtieth of that used in steel manufacture.

A considerable portion of the state's 1917 and 1918 product was utilized in California in making ferro-manganese by electric furnace; besides shipments which were sent East. Some 'chemical' ore was also shipped. For many years the principal producing section has been the Livermore-Tesla district, in Alameda and San Joaquin counties, but exceeded in 1915 by Mendocino and regaining the lead in 1916. In 1918 the largest producing county was Stanislaus, which adjoins San Joaquin on the south, and whose manganese district is a part of the same geological province that includes the Livermore-Tesla district.[2] Manganese is reported to exist in many localities in the state; but for a number of years, particularly since the discontinuance of the chlorination process in the metallurgy of gold, production was relatively unimportant until the activity of the war period just closed.

The production of manganese ore in California for 1918 amounted to 26,075 tons of all grades, having a total value of $979,235 f.o.b. railway

[1]U. S. Geol. Surv., Press Bulletin No. 414, July, 1919, p. 1.
[2]See Plate II, p. 24, Cal. State Min. Bur. Bulletin No. 76, 1918.

shipping point. This is an increase both in quantity and value over the 1917 figures. The 1916 output nearly equaled the entire previous tonnage, 1887-1915, and was about double the value for the same period.

The 1918 output was distributed by counties as follows:

County	Tons	Value
Alameda	2,746	$109,874
Humboldt	1,520	57,751
Imperial	1,241	46,900
Mendocino	1,432	58,962
Plumas	1,544	61,754
Riverside	3,791	152,694
San Joaquin	4,281	117,709
San Luis Obispo	1,907	81,926
Santa Clara	1,059	38,301
Sonoma	173	7,645
Stanislaus	5,753	222,422
Amador, Butte, Kern, Lake, Los Angeles, Nevada, Placer, San Benito, San Bernardino, Tuolumne*	628	23,297
Totals	26,075	$979,235

*Combined to conceal output of a single operator in each.

In 1918 there were two electric smelters in operation in California making ferro-alloys: the plant of the Noble Electric Steel Company at Heroult, Shasta County, and the newer one of the Pacific Electro Metals Company at Bay Point, Contra Costa County.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5,000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows the California output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1904	60	$900
1888	1,500	13,500	1905	--------	----------
1889	53	901	1906	1	30
1890	386	3,176	1907	1	25
1891	705	3,830	1908	321	5,785
1892	300	3,000	1909	3	75
1893	270	4,050	1910	265	4,235
1894	523	5,512	1911	2	40
1895	880	8,200	1912	22	400
1896	518	3,415	1913	--------	----------
1897	504	4,080	1914	150	1,500
1898	440	2,102	1915	4,013	49,098
1899	295	3,165	1916	13,404	274,601
1900	131	1,310	1917	15,515	396,659
1901	425	4,405	1918	26,075	979,235
1902	870	7,140			
1903	1	25	Totals	68,633	$1,789,394

MOLYBDENUM.

Bibliography: Report XIV. Bulletin 67. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum, as the metal, is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter, is its successful substitution for platinum and platinum-iridium in electric contact-making and breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate, the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as the granites and pegmatites. The chief commercial sources have been New South Wales, Queensland, and Norway, with some also from Canada.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. In 1916, was recorded the first commercial shipments of molybdenum ore in California.

The 1917 output included some concentrates assaying up to 58% MoS_2, but the bulk of it was 1.5% ore which was shipped to Denver, Colorado, for concentration. That production came mainly from Shasta County, with smaller amounts from Inyo, Mono and San Diego counties. There were two concentrating plants built in California—one in each of the first and last-named above counties.

In 1917 the plant of the Sacramento Mining Company, lessee, at the Bour mine near Ramona, San Diego County, made a small output of concentrates; but the mine has since reverted to the owner, and the plant dismantled.

In the spring of 1918, a flotation plant operated for a short time by a lessee on the Boulder Creek mine, near Gibson Siding, Shasta County, made a small amount of 90% MoS_2 concentrate. The ore treated carried 2.6% MoS_2. This being the only producer in the state for 1918, the figures are concealed under the 'Unapportioned' item.

The California production of molybdenum ore by years is summarized in the following tabulation:

Year	Tons	Value
1916	8	$9,945
1917	243	9,014
1918	*	*
Totals	251	$18,959

*Concealed under 'unapportioned.'

NICKEL.

Bibliography: Report XIV. U. S. G. S., Bulletin 640-D.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined during the past four years in the course of development work, but not treated nor disposed of, as they are as yet unable to get any smelter to handle it for them. Nickel ore has also been reported from Siskiyou County, west of Gazelle and from San Bernardino County.

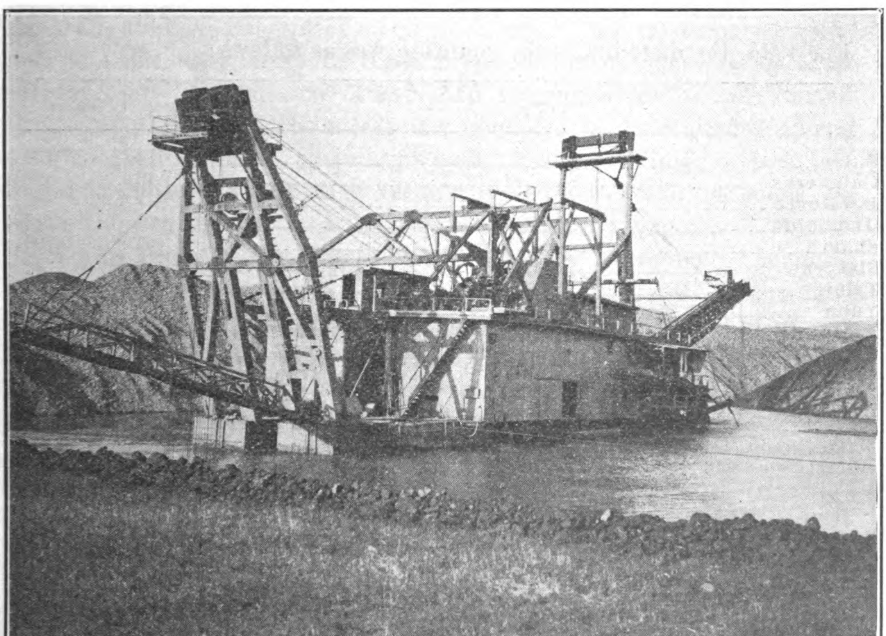
OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII, XIII, XIV. Bulletins 38, 45, 67, 85 (in press). U. S. G. S., Bull. 285.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges operating in Butte, Calaveras, Sacramento and Yuba counties, while the hydraulic and surface sluicing mines of Del Norte, Humboldt, Siskiyou



Dredge No. 11 of the Natomas Company near Folsom, Sacramento County. Of the platinum produced in California in 1918, the gold dredges yielded 97.5 per cent.

and, Trinity and the dredges of Merced and Stanislaus yield a smaller amount.

The production for 1918 amounted to 571 ounces of crude platinum-group metals, valued at a total of $42,788. Of this amount a total of 557 oz., or 97.5%, came from the gold dredges. Crude platinum varies considerably in its purity. That marketed in recent years[1] has averaged around 51% platinum, 3% iridium, and 30% osmiridium or iridosmine. Some platinum is also recovered in the electrolytic refining of blister copper. It has been found[2] that blister copper from several smelters in the United States carries from 0.342 oz. to 1.825 oz. platinum and from 0.607 oz. to 4.402 oz. palladium per 100 tons of blister copper treated. That from Iron Mountain, Shasta County, California, also yields some platinum. Iron in greater or less amount is always alloyed naturally with native platinum, and usually some iridium and osmium.

In addition, there is usually some platinum recovered as a by-product in the gold refinery of the Mint, but which cannot be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. The San Francisco Mint is stated to have recovered as high as 100 ounces of platinum in a single year from this source, some of which unquestionably came from California mines.

"United States refiners of gold and copper produce annually about 1,500 ounces of refined platinum as a by-product, chiefly from copper ore, of both foreign and domestic origin."[3]

For 1918, the distribution by counties, was as follows:

County	Ounces	Value
Butte	†114	$7,723
Calaveras	10	598
Del Norte	1	97
Humboldt	2	140
Shasta	35	2,709
Siskiyou	1	58
Trinity	†41	3,136
Yuba	189	12,930
Amador,† Mendocino, Merced, Nevada, Plumas, Sacramento,† San Joaquin, Stanislaus*	178	15,397
Totals	571	$42,788

*Combined to conceal output of a single operator in each.
†Includ s a small percentage of palladium.

Russia previous to the war, was producing from 90% to 95% of the world's platinum; but, according to U. S. Consular Reports, the yield for 1916 was reduced to one-third of the normal, on account of the "scarcity of labor in the case of hand washings by tributers, and in the case of mechanical dredging plants by the difficulty in obtaining spare parts

[1]U. S. G. S., Min. Res., 1914, Pt. I, p. 336.
[2]Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217-218, 1913.
[3]Hill, J. M., Our mineral supplies. Platinum: U. S. Geol. Surv., Bulletin 666-D, 1917.

for dredges"—both, a reflection of war conditions. Since then it has practically ceased entirely.

The price of the metal has consequently risen to over $100 per troy fine ounce. During 1916, it varied from $90 in January, to $55 in August, $105 December 1st, and closing the year at $82. The 1917 price was from $100 to $105. In 1916, the miners of California received from $43 to $76 per ounce for their crude platinum, and an average of $45.50, as against $29 to $38 per ounce during 1915. In 1917, they received an average of $72 per ounce, and $74.50 in 1918 for crude. During 1918 the U. S. Government commandeered all new platinum produced at a fixed price of $105 per fine ounce. The refiners were licensed and were required to turn over all stocks to the Government. Osmium was quoted at $35-$40 per ounce, and iridium at $175. Osmiridium is a natural alloy of the two.

Recently (July 7, 1919), announcement was made from Washington that the Division of Sales of Munitions of the War Department would dispose of 19,000 ounces of platinum, worth approximately $2,000,000, at a minimum cost of $105 an ounce. The platinum will be allocated to eight of the leading firms dealing in the metal for disposal and each firm, while receiving no commission on the sale, will be given actual cost in handling the platinum.

Dealers in platinum had been expecting this action. It was stated in the trade that the amount of metal to be sold by the Government would not be sufficiently large to force prices down, as there is an acute shortage. Before the war Russia had an annual output of 250,000 ounces of platinum. The metal now is quoted in the United States at $105 to $107 an ounce. In recent weeks manufacturing jewelers have found it difficult to keep their trade supplied with platinum goods, for which the demand is stated to have been unusually large.

Next in importance to Russia as a producer of platinum is Colombia. California is the leading producer in the United States. There have been occasional reports of platinum in California being found in vein materials, but as yet no authentic case has come to the notice of the laboratory of the State Mining Bureau. As platinum and chromite are alike in their association with serpentine derived from basic igneous rocks such as peridotite, pyroxenite and dunite, it is not unlikely that some day platinum will be found in place in some of California's abundant, chrome-bearing serpentine areas. Platinum and chromite have been found intergrown in dunite on the Tulameen River in British Columbia.

Besides its well-known uses in jewelry, dentistry and for chemical-ware, an important industrial development of recent years employs

platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats, and aeroplanes.

Because of the effect of the limited supply and the high prices of platinum on the industrial situation during the war, the jewelers' and dentists' associations voluntarily agreed to curtail consumption of this metal so far as possible. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1904	123	$1,849
1888	500	2,000	1905	200	3,320
1889	500	2,000	1906	91	1,647
1890	600	2,500	1907	300	6,255
1891	100	500	1908	706	13,414
1892	80	440	1909	416	10,400
1893	75	517	1910	337	8,386
1894	100	600	1911	511	14,873
1895	150	900	1912	603	19,731
1896	162	944	1913	368	17,738
1897	150	900	1914	463	14,816
1898	300	1,800	1915	667	21,149
1899	300	1,800	1916	886	42,642
1900	400	2,500	1917	610	43,719
1901	250	3,200	1918	571	42,788
1902	39	468			
1903	70	1,052	Totals	10,722	$285,248

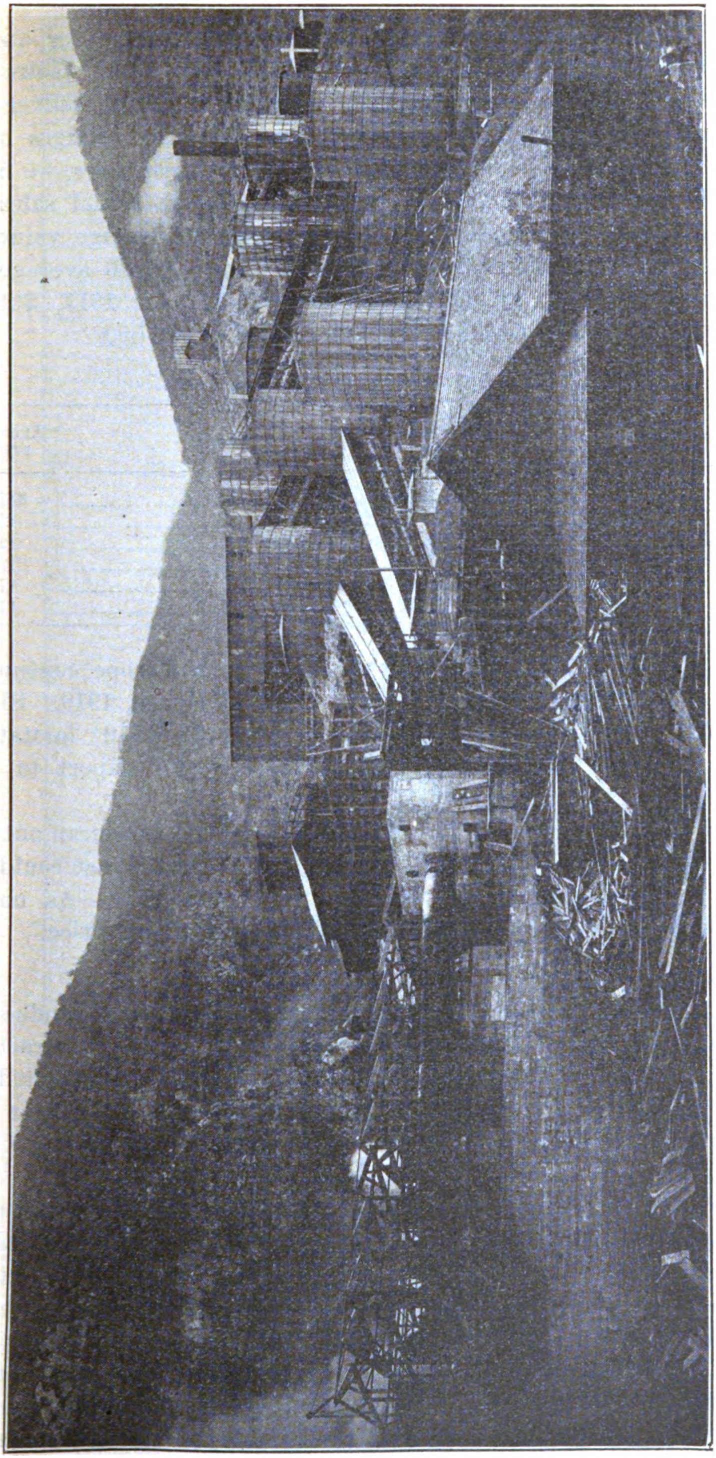
QUICKSILVER.

Bibliography: State Mineralogist Reports IV, X, XII, XIII, XIV, XV. Bulletins 27, 78. U. S. G. S., Monograph XIII.

Quicksilver was produced in 14 counties in 1918, to the amount of 22,621 flasks, valued at $2,579,472, which is a decrease in number of flasks but an increase in value compared with the year 1917, owing to the higher average sale price. The average price received during 1918, according to the producers' reports to the State Mining Bureau, was $114.03, which surpasses the former record of $105.18 for the year 1874. The war caused a considerable rise in the price of quicksilver, due to the prohibition of exports from Europe, to say nothing of its increased use in munitions manufacture. An increased production in California has resulted; but the future is decidedly uncertain.

Prices.

The following table of monthly San Francisco quotations per flask of 75 pounds, will indicate the decided change in the status of quicksilver during the year 1918, as compared with the pre-war price of about $37



Rotary furnaces and wood-stave condensing chambers in new plant of New Idria Quicksilver Mining Company, San Benito County. Photograph by courtesy of H. W. Gould.

per flask. San Francisco is the primary domestic market for quicksilver. The 1914 quotations averaged $49.05 per flask. However, because since the war there has been speculation in quicksilver by parties other than the actual producers, and the price changes have often been rapid so that quotations did not always mean sales, we have since 1914 taken for the average value the average actual sales as reported to us by the producers. This gives us an average value of $81.52 per flask for the year 1915, instead of the $85.80 average of quotations; for 1916, $93.50 instead of $125.89; for 1917, $98.29 instead of $106.33; and for 1918, $114.03 instead of $117.50.

San Francisco Quotations of Quicksilver, 1918.

Month	Average price	Month	Average price
January	$128 06	July	$120 00
February	118 00	August	120 00
March	112 00	September	120 00
April	115 00	October	120 00
May	110 00	November	120 00
June	112 00	December	115 00

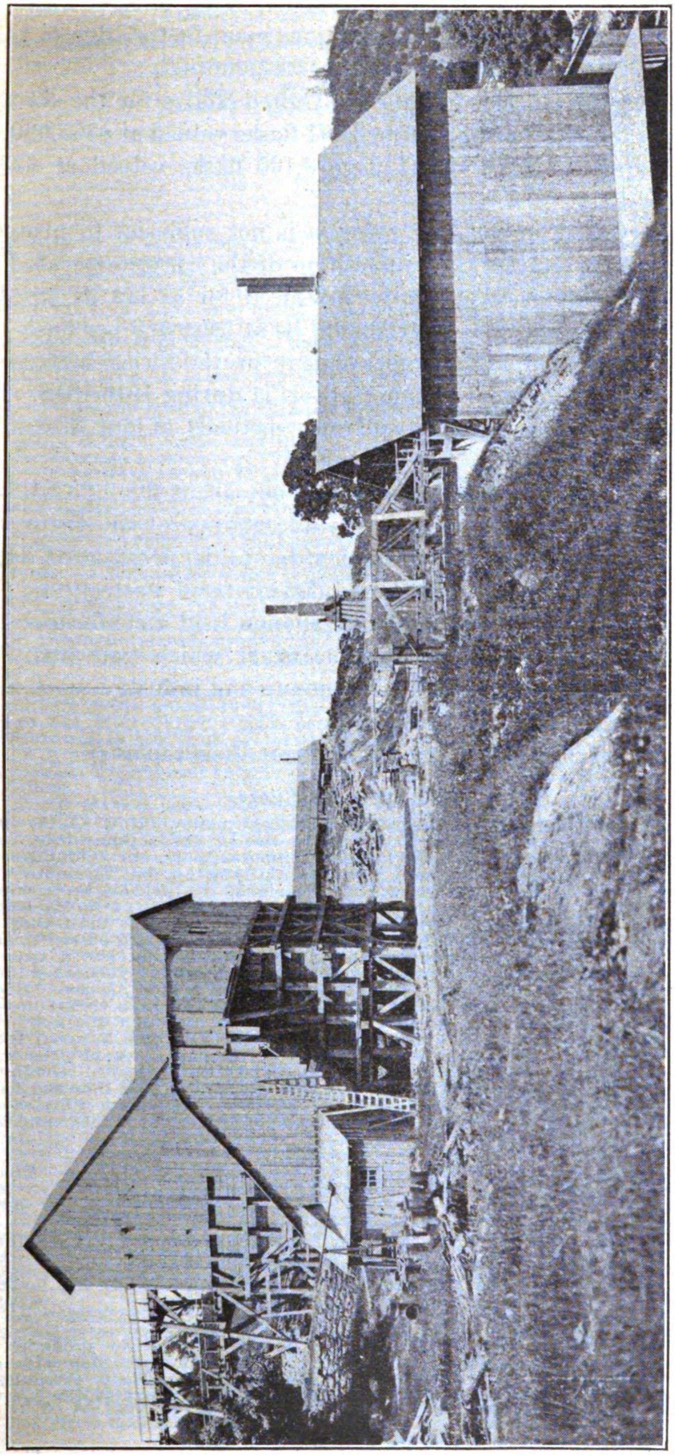
The decline in the price, following the armistice in Europe, continued to a low level of $72.80 average for the month of March, 1919. Since then it has slowly advanced to a present (July 12, 1919) quotation of $100 per flask. A good demand is reported for export to the Orient.

During 1918 the U. S. Government took 40% of the American output of quicksilver at a fixed price of $105 per flask. The balance could be sold in the open market at whatever price obtainable. As noted above, quotations were considerably above the government price.

Present Economic Situation.

The famous mines at Almaden, Spain, are the largest world producers. These mines are owned by the government and operated by contractors using convict labor. The cost of production of quicksilver is stated to have increased from $8.29 a flask in 1900 to $15.22 in 1915. Their ore is high-grade, the material sent to the furnaces averaging 9%-11% mercury.

For two or three years previous to the outbreak of the European war, our normal peace-times consumption of quicksilver in the United States was approximately 25,000 flasks annually; and our domestic production had fallen below 20,000 flasks per year. Of this 25,000-flask peace-time consumption, nearly 50% went into the manufacture of fulminate for explosive caps for mining, quarrying, and sporting arms ammunition as well as military ammunition. Our domestic production being inadequate, partly because of the low price and the lower average tenor of



New reduction plant at the Oat Hill quicksilver mine, Napa County.

the ores mined, necessitated the importation of up to 5,000 flasks annually. The enormous increase in munitions manufacture due to the war, temporarily raised our requirements correspondingly.

The imports of quicksilver into the United States for the six months ending June 30, 1918, amounted to 3,491 flasks valued at $365,930. The exports (mainly to the Orient) were 3,100 flasks valued at $338,680, for the year 1918.

The import duty of 10% *ad valorem* is not sufficient to protect our American miners against the competition of the convict-operated mines of Spain where quicksilver can be produced for as low as $8-$15 per flask, as noted above. The duty should be at least $25 per flask to give us proper protection. The improvement in the price increased the number of operating properties in California during 1916-1918. Lower grade ores are being worked; and new methods of ore dressing and reduction have been tried.

Since the signing of the armistice, all but about five of California's mines have been closed, owing to the uncertainty of the future. The industry here is in danger of extinction due to the prospect of dumping from Europe, because we have not sufficient tariff protection.

In June, 1918, the U. S. Tariff Commission held a conference in San Francisco with the quicksilver producers, at which time many interesting and valuable facts with reference to the industry were brought out.

The following paragraphs are quoted from their report:[1]

"Competitive Conditions.

"In 1914 most American producers were losing money. Now (1918) most of them are making money. Prevailing prices are two or three times those existing before the war. The American industry has temporarily practical immunity from foreign competition. Imports continue in substantial amount, but the metal brought in is supplementary to the domestic supply. No stocks are held by brokers and the disposal of flasks is merely a matter of transportation. Small advances have been made in American metallurgy, which is probably more efficient than that of any of the other producing countries. Both Italy and Austria have had efficient reduction methods. A new furnace was installed in Austria in 1914 that has a capacity of 140 tons a day. This is twice as great as any previous foreign furnace and should still further increase the efficiency of the operation and reduce its cost. Reduction methods in Spain have been costly and inefficient, but the high metal content of the ore counteracted the most wasteful methods, and although the cost per ton of ore treated is seven times that in Austria, the cost per flask is much less.

"The rise in cost of production in the United States has not kept pace with the price increase. There are no data on which to estimate the increased cost in foreign countries since the outbreak of the war, but it is doubtful if the increase has been as great in any country as in the United States. The following estimates of 1918 costs are taken from the Report of the Tariff Commission Conference in San Francisco:

Country	Grade of ore (average)	Production cost per flask
Spain	11 per cent, or 220 pounds a ton	$10 to $25
Austria	1 per cent, or 20 pounds a ton	15 to 28
Italy	0.8 per cent, or 16 pounds a ton	28 to 35
United States	0.25 per cent, or 5 pounds a ton	70 to 75

"Cost figures for the New Idria mine, the largest quicksilver producer in the United States, producing approximately one-third of the total domestic output, were presented by H. W. Gould before the United States Tariff Commission at the conference in San Francisco. The following summary indicates the increase in cost since the beginning of the war:[2]

[1]U. S. Tariff Comm., 2d Annual Report, 1917-1918, pp. 88-90, 1919.
[2]Detailed costs are given in Report of Quicksilver Conference, pp. 27-29, and in auxiliary files of commission.

"**Domestic Costs of Production.**

"New Idria Quicksilver Mining Co.: Comparative costs, 1914-1917.

Year	Tons treated	Flasks produced	Pounds per ton of ore treated	Cost per flask	Cost per ton of ore	Price received per flask
1914	62,578	6,550	7.8	$51 96	$5 44	$41 00
1917	125,445	11,000	6.58	68 66	4 50	92 70

"The net income of the company in 1917, not deducting Federal income taxes, was $215,176.74, as compared with a loss of $43,010.28 in 1914.

"Wages increased 75 per cent during the period 1915-18. This is a serious item as labor amounts to 43 per cent of the total cost of production at New Idria. At the Sulphur Bank mine, a large low grade steam-shovel operation, the labor cost is less, proportionately. At smaller mines, it is greater.

"The average cost of producing a flask of 75 pounds of quicksilver was stated to have been $50 for a period of five years preceding the war, among California producers. As the price of metal was only a little over $35 during this period the miners were operating at a loss.

"The big cost in the production of quicksilver is the mining of the ore. Mining costs have usually been at least three times the reduction costs. At present the ratio is probably a little higher and likely to increase. Reduction costs have been kept down by increased efficiency. The average cost per ton of ore treated in a Scott furnace is between 70 and 80 cents. Fuel requirements as low as 0.031 cords of wood per ton of ore have been reported for a Scott furnace, but it is doubtful if such a small consumption is general. Rotary kilns, recently tested at New Idria, have shown a somewhat better fuel economy than the Scott furnace. The lower first cost and generally cheaper operation may result in a slight decrease in reduction costs, but the great need is for a lowering of the mining costs, if the cost per flask is to be reduced. It is doubtful if this is possible as American mining is efficient and as cheap as possible under high labor and material cost.

"A factor that keeps up the cost of American mining is the pockety nature of many of the deposits that require continual prospecting and the driving of many 'dead' drifts through barren ground to connect kidneys of ore. At one mine (Guadalupe, California,) at least, prospecting accounts for 75 per cent of the underground cost.

"The average cost per flask in 1917 in the United States was between $60 and $70. The average costs of six mines during the first half of 1918, whose output represents 63 per cent of the total United States production, was $61.12 per flask. Five other mines, representing 18 per cent of total production, averaged $91.12 per flask. Of these 11, only 4 properties reported profitable operation in 1916.[3] The average cost of all the quicksilver produced in this period in the United States was between $70 and $75 per flask.

"In the world market American producers are at a distinct disadvantage. No metallurgical advances that can conceivably be made can offset the marked handicap of their low grade ore bodies. Even assuming that, by careful management and technical superiority, the American miner cuts down his costs per ton, in the face of higher wage costs, to a figure lower than the European, the handicap of a possible recovery of only 5 pounds of metal a ton as against 16 to 220 pounds from the same amount of foreign ore is a serious one.

"The decreasing grade of American ore has resulted in a steady reduction in the output of metal per furnace. To offset this reduction some new furnaces have been built; at other properties wet concentration has permitted the treatment of more ore, as the higher grade concentrated product permits a larger yield of metal per furnace. Doubt as to the stability of adequate prices has held up the investment of the capital necessary to build much additional permanent equipment, even during the period of high war prices.

"Although the position of the American producer has been a prosperous one in the war market, his position in a normal market is a real problem. Figures as to foreign production since the outbreak of the war can not be secured, but it is reasonable to assume that war demands have stimulated foreign production as they have the domestic production. Before the war the world's potential production exceeded requirements. The Almaden mine worked only about six months each year. Either Spain or Austria alone could probably supply the peace needs of the entire world. The expanded production may continue for some time after peace is declared. This will result in an accumulation of stocks and a consequent break in price. The new price level can doubtless be met by foreign producers, but the high cost domestic producer must fall out unless his home market is protected.

"It was the practically unanimous opinion of producers attending the San Francisco conference that a price of about $100 a flask is necessary to the continuance of Amerian production at war-time costs. In spite of the large price increases since the war began, operators in the quicksilver industry are few in number. Fully 90 per cent of the output now (1918) comes from companies that were operating four years ago.

"Producers requested a tariff of $35 per flask in addition to the present 10 per cent *ad valorem* duty[4] for protection against foreign competition after the war. The

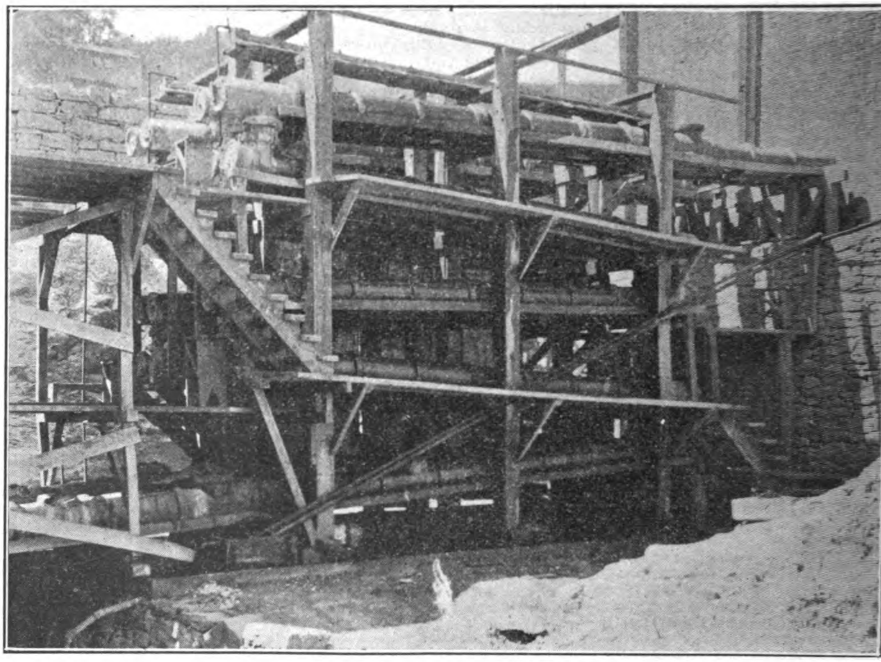
[3]1918 costs, from Report by Non-Ferrous Metals Section, War Industries Board to R. S. Brookings, chairman Price Fixing Committee, Nov. 16, 1918. 1917 costs, General Reports from Industry. No direct investigation of quicksilver mining costs made by U. S. Tariff Commission.

[4]Statement of H. W. Gould, representing the producers of more than one-half the domestic quicksilver, before U. S. Tariff Commission, San Francisco, June 26, 1918. Reports of Conference, p. 56, et seq.

estimate was based upon a $70 to $75 cost in the United States, as compared with the price that Spanish metal can be put down in New York ($40 per flask).

"No claim was made that a lower tariff would result in the abandonment of all domestic quicksilver mines, but it was the opinion that the above protection was necessary to a continuance of a production sufficient to supply home consumption."

There are those who have taken the position that we should buy where we can get the metal the cheapest, and let our own industry ''go hang,'' as ''it is decadent'' anyway. That is certainly not a patriotic attitude; nor a safe one either. Though its total value may be small, as compared with such as gold or copper, yet our American (which means mainly, Californian) quicksilver business has been an important



New arrangement of condenser pipes at Oat Hill quicksilver mine, Napa County.

and vital industry for about 70 years. A quicksilver mine cannot be left idle ''in reserve'' and then opened up at a moment's notice for an emergency.

If, and when, our American quicksilver industry is extinguished by lower-priced foreign competition, we will then be at their mercy, and they can later raise their price to any figure they want and we'll have to pay it. It is not fair to our American capital invested, nor to our California miners (also Nevada and Texas) not to be given protection against the convict-operated and other cheap-labor mines of Spain, Italy and Mexico.

The meat of the situation is summarized by the Tariff Commission in the following:[5]

"In the case of quicksilver, the question can be squarely raised as to whether the production of this metal can be considered an effective American industry, inasmuch as abundant, cheaper sources of supply exist elsewhere. It is particularly an example of an industry whose products are placed on the market at high cost because of the relatively inferior natural resources of this country in the raw material.

"Quicksilver is an essential metal, however, of vital necessity in the conduct of war and widely used in the industries. It is stated that American resources, although low grade, can furnish an adequate supply for many years if a stable and sufficient price be guaranteed. Without tariff protection the United States will be dependent in large part on outside sources for a vital commodity, and a grave question of national expediency is involved."

In the opinion of the quicksilver men, and the writer, the last sentence, above, is the most important of all.

Uses.

The important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

The newest use for quicksilver is the introduction of a small amount into the cylinders of steam turbines to improve the vapor pressure and thus increase efficiency. This mercury is recoverable and can be re-used, so that there is only a small proportional loss.

Quicksilver is an absolutely essential element from a military standpoint, as there has not yet been produced an entirely satisfactory commercial substitute for it in the manufacture of fulminating caps for explosives. However, in order to reduce consumption of the fulminate, some potassium chlorate, picric acid, trinitro-tuluol, or tetranitro-methalmine is sometimes mixed with it. The Ordnance Department of the U. S. Army, however, will accept no substitutes, as they have thus far proven unreliable.

Concentration of Quicksilver Ores.

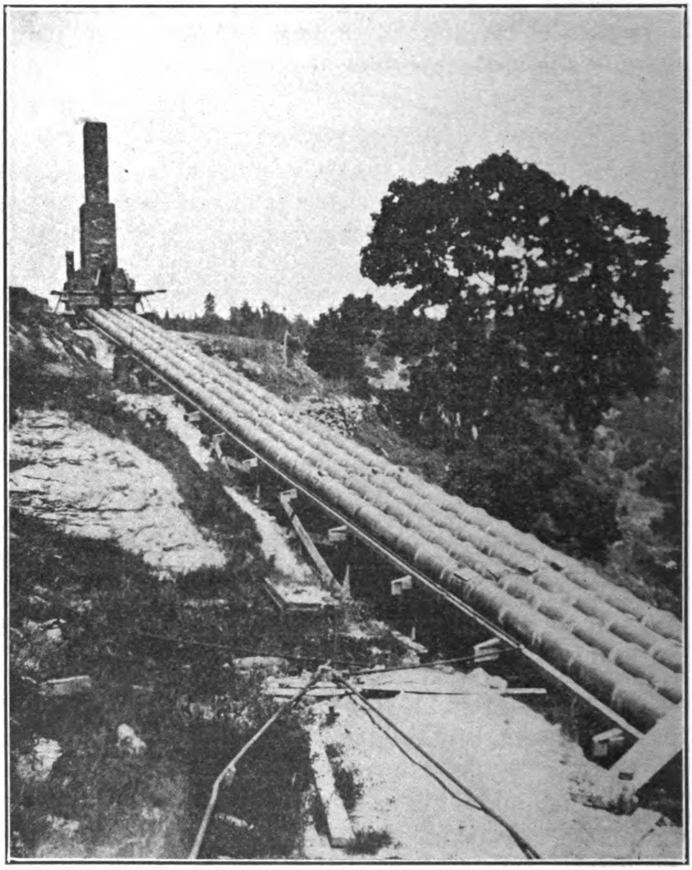
For the above reason, and the fact that California has been, and still is, producing from 70% to 80% of the quicksilver yield of the United States, an investigation of the possibilities of concentration for quicksilver ores, was undertaken by the State Mining Bureau. In the Bureau's investigation a wide variety of ores was tested by water concentration, flotation with oils, and a wet method by solution with an alkaline sulphide. Full details of this work, as well as furnace practices and descriptions of the California mines are given in Bulletin 78, issued during 1918.

New Equipment.

The most notable of recent developments in the metallurgy of quicksilver is the adaptation of the rotary cement-kiln to the reduction of quicksilver ore at the New Idria mine, San Benito County. They have

[5]Op. cit., p. 78.

there installed five such furnaces, with a combined daily capacity of 500 tons. They have also added aerial tramways, an electrical power line from Soledad, and mechanical conveyors, thus reducing the hand labor about the plant. The electric power line will eliminate the hauling of fuel-oil heretofore required for power, though some will still be used for firing the furnaces. The mine and plant were closed down in April and May, 1919, after having been steadily in operation since 1853.



Multiple flue line in condensing system of new plant at Oat Hill quicksilver mine, Napa County.

The lead of the New Idria Company in the matter of rotary furnaces has been followed at the Sulphur Bank mine, Lake County; Bella Union or Rutherford mine, Napa County; Cloverdale mine, Sonoma County, and at the January mine, Yolo County. The first two mentioned are also under the management of Mr. H. W. Gould, general

superintendent of the New Idria Company, though not as New Idria enterprises.

The Oat Hill mine, Napa County, has been reopened by Mr. Murray Innes, of the Oceanic mine, in San Luis Obispo County. A new 40-ton Scott furnace has been built, and began producing quicksilver in January, 1919. New features of this installation are: an ore-drier on top of the furnace, heated by waste gases; and the division of the flues into four lines of 12-inch tile-pipe instead of a single line of larger size. This gives a greater area of cooling surface, and is stated to be showing very satisfactory results. The ore-drier also serves as a continuous, automatic feeder to the furnace.

Production.

Though some domestic yield of this metal is now obtained from Texas, Nevada, Arizona, and Oregon, the bulk of the output still comes from California.

The distribution of the 1918 product, by counties, was:

County	Amount, flasks	Value
Fresno	35	$3,652
Lake	1,540	172,173
Napa	1,297	143,850
San Benito	10,715	1,234,027
Santa Clara	3,977	478,524
Solano	593	59,122
Sonoma	2,417	280,333
Kern, Kings, Monterey, San Luis Obispo, Santa Barbara, Trinity, Yolo*	2,047	207,791
Totals	22,621	$2,579,472

*Combined to conc al output of a single operator in each.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation. Though the New Almaden mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (though the yield was small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information were used: For 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also

State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1886	29,981	$1,064,326	$35 50
1851	27,779	1,859,248	66 93	1887	33,760	1,430,749	42 38
1852	20,000	1,166,600	58 33	1888	33,250	1,413,125	42 50
1853	22,284	1,235,648	55 45	1889	26,464	1,190,880	45 00
1854	30,004	1,663,722	55 45	1890	22,926	1,203,615	52 50
1855	33,000	1,767,150	53 55	1891	22,904	1,036,406	45 25
1856	30,000	1,549,500	51 65	1892	27,993	1,139,595	40 71
1857	28,204	1,374,381	48 73	1893	30,164	1,108,527	36 75
1858	31,000	1,482,730	47 83	1894	30,416	934,000	30 70
1859	13,000	820,690	63 13	1895	36,104	1,337,131	37 04
1860	10,000	535,500	53 55	1896	30,765	1,075,449	34 96
1861	35,000	1,471,750	42 05	1897	26,691	993,445	37 28
1862	42,000	1,526,700	36 35	1898	31,092	1,188,626	38 23
1863	40,531	1,705,544	42 08	1899	29,454	1,405,045	47 70
1864	47,489	2,179,745	45 90	1900	26,317	1,182,786	44 94
1865	53,000	2,432,700	45 90	1901	26,720	1,285,014	48 46
1866	46,550	2,473,202	53 13	1902	29,552	1,276,524	43 20
1867	47,000	2,157,300	45 90	1903	32,094	1,335,954	42 25
1868	47,728	2,190,715	45 90	1904	*28,876	1,086,323	37 62
1869	33,811	1,551,925	45 90	1905	24,655	886,081	35 94
1870	30,077	1,725,818	57 38	1906	19,516	712,334	36 50
1871	31,686	1,999,387	63 10	1907	17,379	663,178	38 16
1872	31,621	2,084,773	65 93	1908	18,039	763,520	42 33
1873	27,642	2,220,482	80 33	1909	16,217	773,788	47 71
1874	27,756	2,919,376	105 18	1910	17,665	799,002	45 23
1875	50,250	4,228,538	84 15	1911	19,109	879,205	46 01
1876	75,074	3,303,256	44 00	1912	20,600	866,024	42 04
1877	79,396	2,961,471	37 30	1913	15,661	630,042	40 23
1878	63,880	2,101,652	32 90	1914	11,373	557,846	49 05
1879	73,684	2,194,674	29 85	1915	14,199	1,157,449	81 52
1880	59,926	1,857,706	31 00	1916	21,427	2,003,425	93 50
1881	60,851	1,815,185	29 83	1917	24,382	2,396,466	98 29
1882	52,732	1,488,624	28 23	1918	22,621	2,579,472	114 03
1883	46,725	1,343,344	28 75				
1884	31,913	973,347	30 50	Totals	2,160,349	$104,572,032	
1885	32,073	986,245	30 75				

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII, XIII, XIV, XV. Bulletin 67. Min. & Sci. Press, March 1, 1919.

Silver in California is produced largely as a by-product from its association with copper, lead, zinc, and gold ores. As explained under the heading of Gold, the following figures are those of the U. S. Geological Survey. The average price of silver during 1918 was $1.00 per ounce at New York as compared with 54.8¢ in 1914; 50.7¢ in 1915; 65.8¢ in 1916, and 82.4¢ in 1917.

Prices for 1919 are still higher. The maximum price fixed by the Government was $1.01¾ per ounce for some months; and exports were

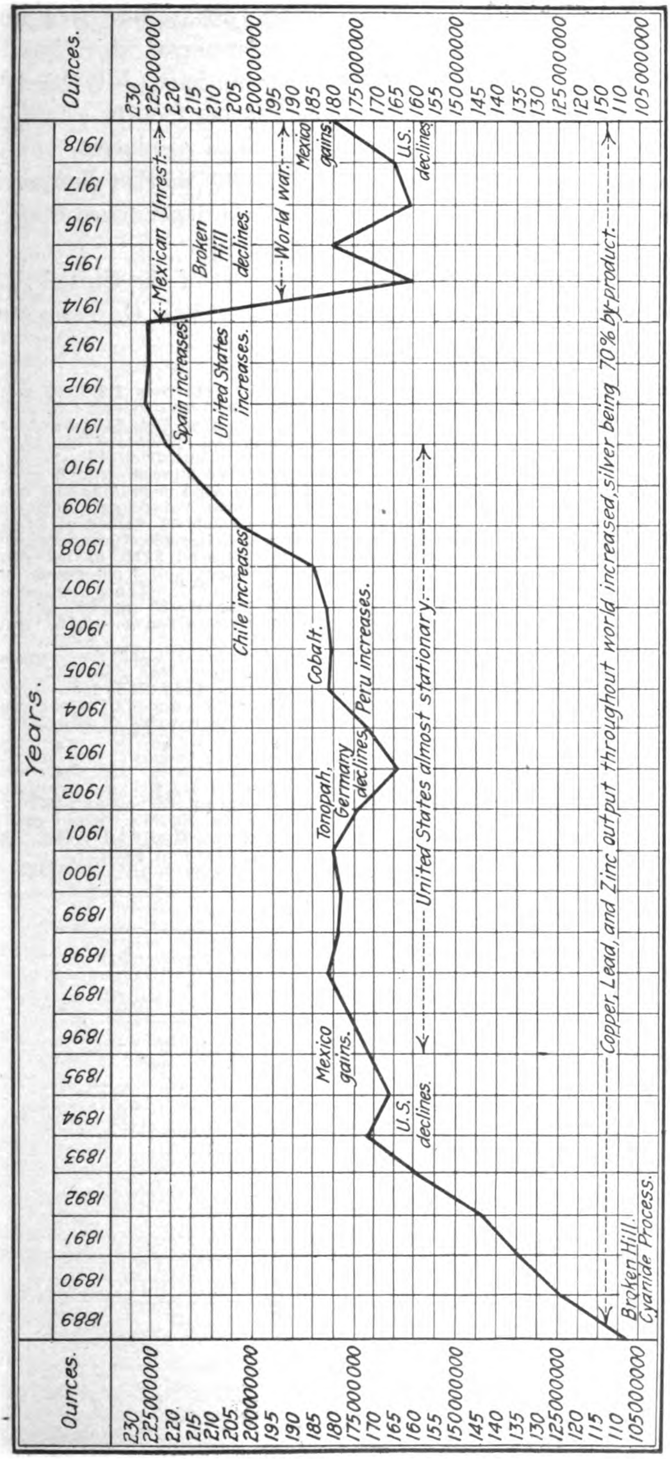


Chart Showing Silver Production of World For 30 Years.
Courtesy of the Mining and Scientific Press.

under license only. Now, all restrictions are off. There is a heavy demand for silver from India and China, the former of which has long been termed the "sink of silver." Present quotations (July 12, 1919) are around $1.06 per ounce. A movement is on foot to establish a Silver Exchange in New York, so that American producers, bankers, and consumers can keep in closer touch with the market fluctuations and their underlying causes; and also to obviate dependence upon the London market as an intermediary, as in the past.

The following extract is quoted from the report of the United States Geological Survey, through the courtesy of Mr. Chas. G. Yale, statistician in charge of the San Francisco office:

"The deep-mine production of silver in California in 1918 was 1,397,802 ounces, valued at $1,397,802, a decrease in quantity of 347,720 ounces and in value of $35,244. The larger portion of the output, 982,619 fine ounces, valued at $982,619, was derived from crude smelting ore. Siliceous ore, milled and smelted, yielded $228,332. The largest output of silver in 1918 came from Inyo County (not from Shasta as has been usual for years), which produced from copper ores 960 ounces, valued at $960; from siliceous ore, 3,456 ounces, valued at $3,456; from lead ores, 433,242 ounces, valued at $433,242; and from copper-lead ores, 3,890 ounces, valued at $3,890. This makes a total yield of silver from Inyo County of 441,548 ounces, valued at $441,548. Shasta County followed Inyo in yield of silver, the output being 420,410 ounces, valued at $420,410, as compared with 631,921 ounces in quantity and $520,703 in value in 1917. The total silver derived from deep mines of all classes and from placer mines in California in 1918 was 1,427,711 ounces, valued at $1,437,711. The silver obtained from refining placer gold mined in the state in 1918 was 29,909 ounces, valued at $29,909. The largest producer of placer silver was Yuba County—13,569 ounces, valued at $13,569.

"From 1,538,960 tons of siliceous ore there was derived 228,332 fine ounces of silver, valued at $228,332; from 908,059 tons of copper ore was obtained 669,711 ounces of silver, valued at $669,711; from lead ores came 448,547 ounces of silver, valued at $448,547; from copper-lead ores was derived 12,820 ounces of silver, valued at $12,820; and from zinc ores, 38,392 ounces of silver, with a value of $38,392."

* * * * * * *

"From the siliceous ore and old tailings treated in California in 1918, the recovery of silver by amalgamation was 71,103 fine ounces, valued at $71,103; by cyanidation, 60,870 ounces, valued at $60,870; by chlorination, 3,631 ounces, valued at $3,631; and from concentrates sent to smelters 92,728 ounces, valued at $92,728. From smelting ores, silver was recovered amounting to 1,169,470 ounces, valued at $1,169,470. From the placer mines 29,909 ounces of silver were recovered, valued at $29,909."

The distribution of the 1918 silver yield, by counties, was as follows:

County	Value
Amador	$29,590
Butte	2,410
Calaveras	84,150
Del Norte	4
El Dorado	722
Fresno	37
Humboldt	72
Imperial	1,248
Inyo	441,548
Kern	7,817
Madera	4,206
Mariposa	5,083
Merced	254
Mono	22,727
Nevada	72,557
Placer	22,432
Plumas	156,750
Riverside	1,541
Sacramento	4,637
San Bernardino	88,712
Shasta	420,410
Sierra	2,121
Siskiyou	14,501
Stanislaus	592
Trinity	6,912
Tuolumne	21,425
Yuba	13,796
Marin, Modoc, Napa, San Joaquin, San Luis Obispo*	1,607
Total	$1,427,861

*Combined to conceal output of a single operator in each.

The value of the silver produced in California each year since 1880 has been as follows, the data previous to 1887 being taken from the reports of the Director of the Mint:

Year	Value	Year	Value
1880	$1,140,556	1901	[2]$571,849
1881	750,000	1902	616,412
1882	845,000	1903	517,444
1883	1,460,000	1904	873,525
1884	[1]4,185,101	1905	678,494
1885	2,568,036	1906	817,830
1886	1,610,626	1907	751,646
1887	1,632,001	1908	873,057
1888	1,700,000	1909	1,091,092
1889	1,065,281	1910	993,646
1890	1,060,613	1911	673,336
1891	953,157	1912	799,584
1892	463,602	1913	832,553
1893	537,158	1914	813,938
1894	297,332	1915	851,129
1895	599,790	1916	1,687,345
1896	422,464	1917	1,462,955
1897	452,789	1918	1,427,861
1898	414,055		
1899	504,012	Total	$39,719,772
1900	[2]724,500		

[1]Lawver, A. M., in Production of Precious Metals in United States: Report of Director of Mint, 1884, p. 175; 1886.

[2]Recalculated to 'commercial' from 'coining value,' as originally published.

TIN.

Bibliography: Report XV. Bulletin 67.

Tin is not at present produced in California; but during 1891-1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets having been taken out, as yet.

The principal source of the world's supply of tin is the Straits Settlements on the Malay Peninsula, followed in second rank by Bolivia. Siam, Burma and Cornwall are also important sources. A measureable amount of the metal is also recovered by de-tinning scrap and old cans.

Total output of tin in California:

Year	Pounds	Value
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

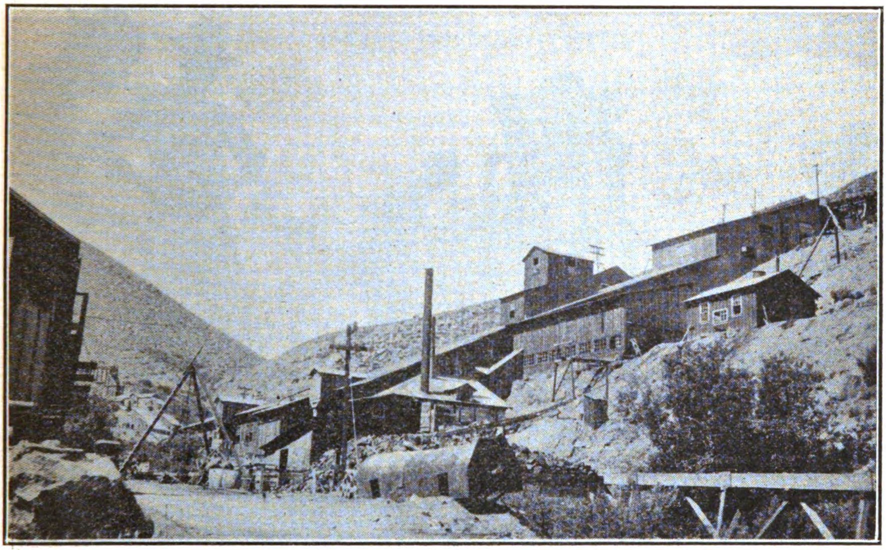
Bibliography: Report on San Bernardino County, 1917; Report XV. Bulletins 38, 67. U. S. G. S., Bull. 652. Proc. Colo. Sci. Soc., Vol. XI. South Dakota School of Mines, Bulletin No. 12.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys, permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high-speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chronium, nickel, cobalt, or vanadium, are sometimes also included.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%-85% tungsten). The specific gravity of the pure metal, 19.3-21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3,267° C. (5,913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires

are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Tungsten ore is produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübnerite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output



Tungsten Mines Company's 300-ton mill at Tungsten City, Inyo County.
Photo by Emile Huguenin.

has in some years equalled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent. Burma, the largest producer, reported a yield of approximately 3,300 tons[2] of wolframite concentrates for 1917, most of which was obtained from placers, in part associated with cassiterite (tin oxide).

Imports of foreign tungsten ores into the United States during 1918 amounted to 10,362 tons valued at $11,409,237, compared with 4,357 tons valued at $4,467,608 in 1917. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the present low market prices, practically all of the tungsten mines in the United States are now closed down.

[1]U. S. G. S. Bull. 652, p. 32.
[2]U. S. Commerce Reports, No. 167, July 18, 1918.

The value of the ore is based upon the content of tungstic trioxide (WO_3), and quotations are commonly made per unit (each 1%) of WO_3 present.

In California in 1918, there were marketed 1,982 tons of high-grade ore and concentrates, valued at $2,832,222, which is a decrease both in quantity and in value, as compared with the 1917 output. This slightly exceeds Colorado's estimated output of 1910 tons[3] for 1918. The market prices prevailing during 1918 ranged between $20 and $26, with the

A dry concentrator working on scheelite ground at Atolia, San Bernardino County.

average about $23.75, as indicated by the reports of sales. The tonnages here shown are re-calculated to a basis of 60% WO_3, the materials reported varying from ore assaying 2% to concentrates running as high as 75%. Most of the concentrates ranged about 63%. Previous to 1915, a single company produced almost all of California's tungsten. During the latter part of 1915, and the early months of 1916, because of the high prices prevailing, prospecting was much stimulated, and the known tungsten-bearing areas have been considerably extended both in San Bernardino and Kern counties. Some shipments have been made from mines opened up in the Clark Mountain and New York Mountains districts in eastern San Bernardino County. In these latter areas,

[3]U. S. Geol. Surv., Press Bull. No. 394, January 1919.

wolframite and hübnerite are the principal ores, with some scheelite, while at Atolia it is scheelite only. Scheelite ore is also extracted in Inyo County near Bishop, and three concentrating mills have been in operation there. The Nevada County ore is also scheelite.

Distribution of the 1918 output was as follows:

County	Tons	Value
Inyo	589	$854,025
San Bernardino	1,347	1,911,966
Kern and Nevada*	46	66,231
Totals	1,982	$2,832,222

*Combined to conceal output of a single mine in Nevada County.

The annual value of tungsten produced in California since the inception of the industry is given herewith:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905		$18,800	1913		$234,673
1906		189,100	1914		180,575
1907		120,587	1915	962	1,005,467
1908		37,750	1916	2,270	4,571,521
1909		190,500	1917	2,466	3,079,013
1910		208,245	1918	1,982	2,832,222
1911		127,706			
1912		206,000	Total		$13,002,159

VANADIUM.

Bibliography: Report XV. Bulletin 67. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has as yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies have done considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Late in 1917, some ore-carrying lead vanadate was discovered in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties. Vanadium has also been reported near Lotus in El Dorado County. There is a growing demand for vanadium, for use in the steel industry.

Quotations on the basis of vanadic acid are misleading. During 1918 prices ranged around $4-$5 per pound of vanadium contained in ferrovanadium. The cost of recovery is high. The association of copper is very detrimental.

ZINC.

Bibliography: Report XIV, XV. Bulletins 38, 67.

During 1918, zinc was produced in Shasta, Inyo and San Bernardino counties to the amount of 5,565,561 pounds, valued at $506,466. This is a decrease of over half that of 1917 both in tonnage and value, due to the lower prices prevailing. The average price for the year was 9.1¢ per pound as compared to 5.1¢ during 1914; 14.2¢ in 1915; 13.4¢ in 1916, and 10.2¢ in 1917, showing a steady decline from the high-level prices of 1915.

The zinc ores of Shasta County are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver ores. The ores were mainly shipped to eastern smelters for treatment. The electrolytic zinc plant of the Mammoth Copper Company at Kennett with a capacity of 100 tons of spelter per month was in operation during 1918, but has since closed down. It treated bag-house fume. The Mammoth did not ship nor treat any raw zinc ores during 1918. The electrolytic plant at the Bully Hill copper mine, Shasta County, is stated to be in operation; also one at the Afterthought mine. Both of these treat raw ores direct.

The production, by counties, was as follows:

County	Pounds	Value
Inyo	2,517,045	$229,051
San Bernardino	2,824	257
Shasta	3,045,692	277,158
Totals	5,565,561	$506,466

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1914	399,641	$20,381
1907	177,759	10,598	1915	13,043.411	1,617,383
1908	54,000	3,544	1916	15,950,565	2,137,375
1909	----------	----------	1917	11,854,804	1,209,190
1910	----------	----------	1918	5,565,561	506,466
1911	2,679,842	152,751			
1912	4,331,391	298,866	Totals	55,420,921	$6,033,965
1913	1,157,947	64,845			

CHAPTER FOUR.

STRUCTURAL MATERIALS.

As indicated by this chapter heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1918 was valued at $18,848,677, as compared with a total value of $17,440,276 for the year 1917. Deposits of granite, marble and other building stones are distributed widely throughout this area, and slowly but surely transportation and other facilities are being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though since 1913 it has fallen slightly below its high-level mark.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides recently taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an annual output worth approximately $2,000,000, has slowly decreased, due to the popularity of cement and concrete; nevertheless, this item will be an important one for many years to come, and of course, a market for fire and fancy brick of all kinds will never be lacking.

Fifty-three counties contributed to this structural total for 1918, and there is not a county in the state which is not capable of some output of at least one of the materials under this classification.

Except for construction work directly connected with war activities, much of which was of only a temporary nature, the general building situation showed a decline in 1917 and 1918 from previous years. This was due to the war's demands, priority of freight schedules, and the request of the Government to defer all but urgent construction for the period of the war. The outlook for 1919 is very promising for a renewal of activity along all building lines, particularly highway construction.

The following table gives the comparative figures for the amounts and value of structural materials produced in California during the years 1917 and 1918:

Substance	1917		1918		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	5,590 tons	$18,580	2,561 tons	$9,067	$9,513—
Brick and tile		2,532,721		2,363,481	169,240—
Cement	5,790,734 bbls.	7,544,282	4,772,921 bbls.	7,969,909	425,627+
Chromite	52,379 tons	1,130,298	73,955 tons	3,649,497	2,519,199+
Granite		221,997		139,861	82,136—
Lime	500,730 bbls.	311,380	436,843 bbls.	461,315	149,935+
Magnesite	209,648 tons	1,976,227	83,974 tons	803,492	1,172,735—
Marble	24,755 cu. ft.	62,950	17,428 cu. ft.	49,898	13,052—
Sandstone	31,090 cu. ft.	7,074	900 cu. ft.	400	6,674—
Miscellaneous stone		3,634,767		3,404,157	230,610—
Totals		$17,440,276		$18,851,077	
Net increase					$1,410,801+

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 16, 32.

Asphalt was for a number of years accounted for in reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be a partial duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

According to the U. S. Geological Survey, the war stimulated activity in the domestic markets for asphaltic materials derived from crude petroleum and for imported asphalt, but relative abundance and adaptability of those materials has lessened the demand for the native bitumens and for the various types of bituminous rock produced in this country.

The production of refinery asphalt from 14 refineries in California has averaged between 200,000 tons and 250,000 tons, worth approximately $2,000,000, per year, for several years past. California leads all other states of the union in such production, as her crude oils are almost entirely of asphaltic base.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV.

The manufacture of asphalt at the oil refineries has almost eliminated the industry of mining bituminous rock, but small amounts of the latter are still used occasionally for road dressing. The production during 1918 from one quarry each in Santa Cruz, Santa Barbara and San Luis Obispo counties was 2,561 tons, valued at $9,067, compared with 5,590 tons and $18,580 in 1917.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1904	45,280	$175,680
1888	50,000	257,000	1905	24,753	60,436
1889	40,000	170,000	1906	16,077	45,204
1890	40,000	170,000	1907	24,122	72,835
1891	39,962	154,164	1908	30,718	109,818
1892	24,000	72,000	1909	34,123	116,436
1893	32,000	192,036	1910	87,547	165,711
1894	31,214	115,193	1911	75,125	117,279
1895	38,921	121,586	1912	44,073	87,467
1896	49,456	122,500	1913	37,541	78,479
1897	45,470	128,173	1914	66,119	166,618
1898	46,836	137,575	1915	17,789	61,468
1899	40,321	116,097	1916	19,449	66,561
1900	25,306	71,495	1917	5,590	18,580
1901	24,052	66,354	1918	2,561	9,067
1902	33,490	43,411			
1903	21,944	53,106	Totals	1,149,839	$3,502,329

BRICK and TILE.

Bibliography: Reports XIV, XV. Bulletin 38.

As would be expected in a state with diversified and widespread mineral resources, a great variety of brick is annually produced in California, including common, fire, pressed, glazed, sand-lime, and others. As far as possible the different kinds have been segregated in the following tabulation. We also include under this heading the various forms of hollow building 'tile' or blocks, instead of under industrial pottery clays as in the reports previous to 1915.

The clay industries throughout the country were adversely affected by the war-time restrictions on building operations, and particularly during 1918 by a 50% cut in their fuel and power allowances by the Federal Fuel Administrator. This condition is reflected in the lower output figures of nearly all classes of clay products for 1918, as compared to 1917.

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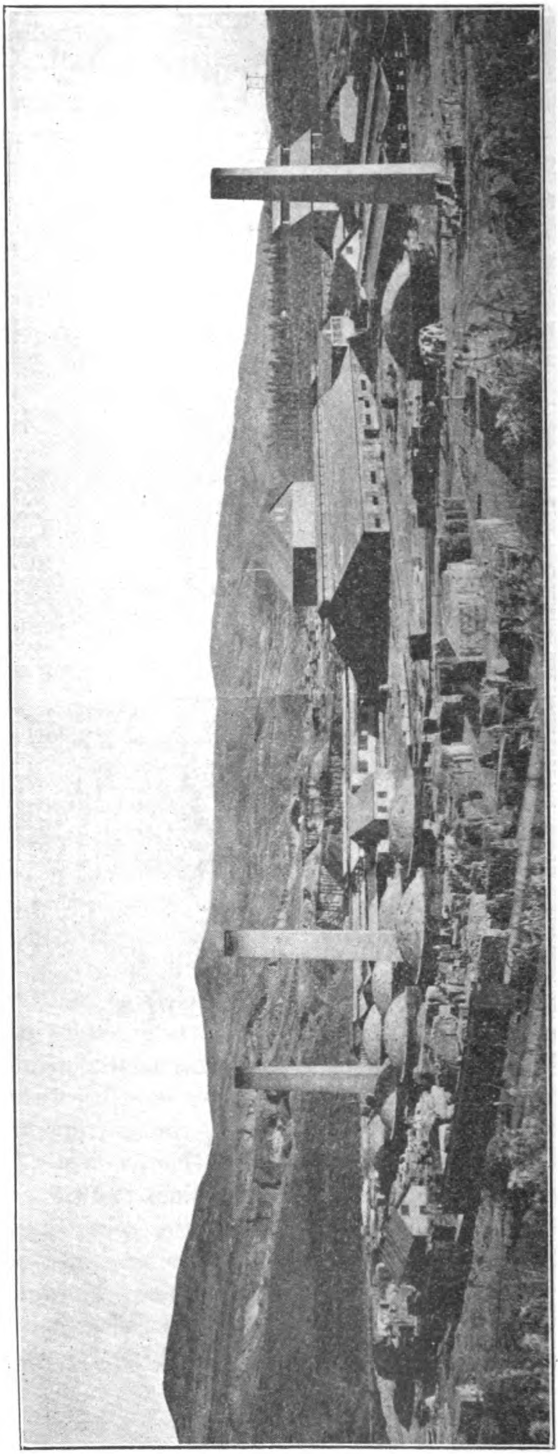


Los Angeles Pressed Brick Company's Alberhill plant, Riverside County. The clay pits are in the left background. Photo by Emile Huguenin.

The detailed figures of brick and tile production for 1918, by counties, are given in the following tabulation:

Brick Production for 1918, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified		Hollow building tile or blocks		Total value
	Amount, M	Value	Amount, M	Value	Amount, M	Value	Tons	Value	
Alameda	7,783	$75,552	1,407	$42,210	5,042	$131,050			$248,812
Contra Costa	9,567	95,892							95,892
Fresno	8,040	88,934							88,934
Kern	1,678	16,380							16,380
Los Angeles	39,618	323,735	6,890	257,231	1,873	87,710	[1]18,630	$121,903	790,579
Orange	477	3,869							3,869
Riverside	528	4,738	8,200	226,734			6,287	49,089	280,561
San Diego	2,059	16,480							16,480
Santa Clara	6,792	62,000							62,000
Humboldt, Imperial, Marin, Sacramento, San Joaquin, Santa Barbara, Shasta, Tehama, Tulare*	24,205	206,697							
Amador, Contra Costa, Placer, San Joaquin*			9,214	375,326					
Contra Costa, Fresno, Placer, Riverside, Sacramento*					3,001	78,394			
Alameda, Imperial, Placer, Sacramento, San Diego, Santa Clara, Tulare*							9,901	99,557	759,974
Totals	100,747	$894,277	25,711	$901,501	9,916	$297,154	34,818	$270,549	$2,363,481

*Combined to conceal output of a single producer in each.
[1]Includes "Larsite," a burned clay aggregate used in concrete shipbuilding; also radial sewer blocks; also chimney blocks.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for building tile being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Thousands	Value	Year	Thousands	Value
1893	103,900	$801,750	1907	362,167	$3,438,951
1894	81,675	457,125	1908	332,872	2,506,495
1895	131,772	672,360	1909	333,846	3,059,929
1896	24,000	524,740	1910	340,883	2,934,731
1897	97,468	563,240	1911	327,474	2,638,121
1898	100,102	571,362	1912	337,233	2,940,290
1899	125,950	754,730	1913	358,754	2,915,350
1900	137,191	905,210	1914	270,791	2,288,227
1901	130,766	860,488	1915	180,538	1,678,756
1902	169,851	1,306,215	1916	206,960	2,096,570
1903	214,403	1,999,546	1917	----------	2,532,721
1904	281,750	1,994,740	1918	----------	2,363,481
1905	286,618	2,273,786			
1906	277,762	2,538,848	Total value	----------	$47,617,762

CEMENT.

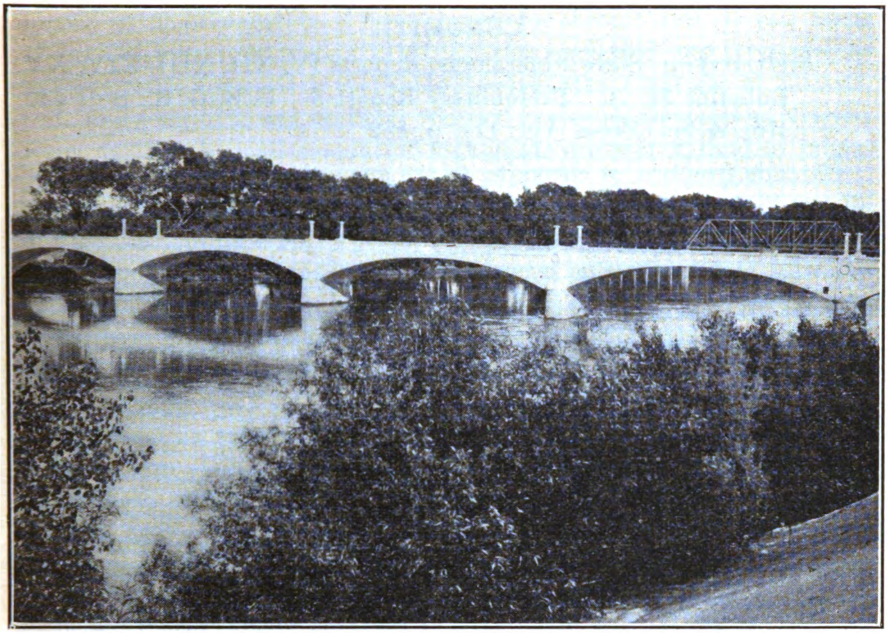
Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV. Bulletin 38.

Cement is one of the most important structural materials in the output of the state. During 1918 there was produced a total of 4,772,921 barrels, valued at $7,969,909, being a decrease in quantity but an increase in value over the 1917 figures. This output comes from nine operating plants in seven counties, employing approximately 1,800 men.

The outstanding features of the 1918 production are: the greatly increased average price per barrel, and the entry of one new plant in California, that of the Old Mission Portland Cement Company at San Juan, San Benito County.

Several of the cement plants recovered potash-bearing materials as by-products, notably: the Riverside Portland Cement Company, Riverside County; California Portland Cement Company and Southwestern Portland Cement Company, San Bernardino County; Santa Cruz Portland Cement Company, Santa Cruz County. The first-named was the pioneer in this work. The Golden State Portland Cement Company, San Bernardino County, also added such equipment to its plant, but did not produce potash on a commercial scale until the close of the year.

The cement industry is so centralized that it is not possible to apportion the production to the counties in which plants are located without making private business public. With the exception of San Bernardino, no county has more than one cement plant. The three operating plants in San Bernardino County, in 1918, made a total of 1,027,635 barrels, valued at $1,453,962; the balance coming from a single plant in each of



Concrete State Highway Bridge over the American River on North Twelfth Street, Sacramento.

the following counties: Contra Costa, Kern, Napa, Riverside, San Benito, Santa Cruz and Solano.

'Portland' cement was first commercially produced in the state in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco. While the total figures are not of the same magnitude as those for gold and petroleum, the growth of the industry has been more than rapid, and a comparison of the annual figures representing the output since the inception of the industry is of interest.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1906	1,286,000	$1,941,250
1892	5,000	15,000	1907	1,613,563	2,585,577
1893	----------	----------	1908	1,629,615	2,359,692
1894	8,000	21,600	1909	3,779,205	4,969,437
1895	16,383	32,556	1910	5,453,193	7,485,715
1896	9,500	28,250	1911	6,371,369	9,085,625
1897	18,000	66,000	1912	6,198,634	6,074,661
1898	50,000	150,000	1913	6,167,806	7,743,024
1899	60,000	180,000	1914	5,109,218	6,558,148
1900	52,000	121,000	1915	4,918,275	6,044,950
1901	71,800	159,842	1916	5,299,507	6,210,293
1902	171,000	423,600	1917	5,790,734	7,544,282
1903	640,868	968,727	1918	4,772,921	7,969,909
1904	969,538	1,539,807			
1905	1,265,553	1,791,916	Totals	61,732,682	$82,085,861

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV. Bulletins 38, 76. Preliminary Report 3. U. S. G. S., Bull 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 73,955 short tons of all grades valued at $3,649,497 f.o.b. shipping point was mined and shipped in California during the year 1918. This is an increase both in quantity and total value over 1917, which showed 52,379 tons worth $1,130,298. Chromite is widely distributed in this state, the 1918 output coming from 29 counties, the larger amounts being credited to El Dorado, San Luis Obispo, Del Norte, Siskiyou, and Placer in the order named.

The above total of 73,955 short tons of all grades as marketed is equivalent to approximately 59,000 tons of 50% Cr_2O_3 ore. This is in fair agreement with the 56,200 long tons of 50% ore credited to California for 1918 by the U. S. Geological Survey.[1] The ores as marketed assayed from 33% to at least as high as 55% Cr_2O_3, with the average running close to 40%. In some concentrating mills ores as low as 10% Cr_2O_3 were handled, and the concentrates usually assayed from 40% to 50%.

Economic Conditions.

Chromite is one of several of California's minerals most affected by the economic conditions brought about by the European war. The major portion of our domestic requirements for chrome is for consumption in the steel mills of the East. Formerly, most of that used was imported from Rhodesia and New Caledonia, and they are still the more important sources. The reports of the U. S. Department of Commerce show the foreign imports of chromic iron for the five years 1913-1918 (inc.) to have been 49,772; 74,455; 115,886; 72,063, and 100,142 long tons, respectively. Similarly to conditions discussed herein under manganese (see *ante*), the increased demand for steel products also increased the necessity for chromite as a refractory and for the preparation of ferro-chrome. Our own domestic sources supplied a part of the increased demand, and some tonnage came fom Canada, Cuba and Brazil.

According to Dolbear,[2]

"to be readily salable chrome ore should contain at least 40% chromic oxide (Cr_2O_3) and less than 8% silica (SiO_2). Some ore is sold which carries not more than 30% Cr_2O_3; sometimes SiO_2 as high as 10% to 15% is permitted. Ore containing 40% Cr_2O_3 is more satisfactory in fire brick manufacture than 30% or 50% ore. When other grades are purchased they are sometimes crushed and mixed with higher or lower grades, as may be required, to secure a 40% product."

The major consumption of chromic iron ore is for its use as a refractory lining in smelting furnaces for steel and copper. A smaller portion

[1] Press Bulletin No. 403, p. 2, April, 1919.
[2] Dolbear, S. H., Min. and Sci. Press, April 21, 1917, p. 554.

is used in the preparation of ferro-chrome for chrome-steel alloys. Some of the California product in 1916-1918 was converted into ferro-chrome in the electric furnaces of the Noble Electric Steel Company at Heroult, Cal., and some of it was similarly reduced in electric furnaces at Niagara Falls, N. Y. A small amount of high-grade ore was utilized in preparation of chromates for tanning.

A report, designated as Bulletin No. 76, of the State Mining Bureau, was issued in 1918, giving a detailed account of California's resources in both manganese and chromite.

The mining of chromite in 1918 was greatly stimulated by the urgings of the Government and other agencies, as well as the high prices offered. Actual shipments, though gradually increasing, did not reach their greatest stride until late summer. This was due to the fact that many deposits, particularly in northwestern California, are from 25 to 40 miles from rail or water transportation, and considerable road building had to be done before ore could be moved. Just at this juncture, when many properties were starting or about to start shipments, like a thunderbolt out of a clear sky came the word late in September from eastern buyers that they were overstocked and no longer in the market for chromite. Then while the bewildered producer and prospective producer were trying to find out what it all meant, the armistice was signed in France on November 11th, thus putting a stop to the war demands and contracts.

The situation is well described in the following article:[3]

"THE CHROMITE SITUATION.

"In the early part of 1918 the shortage of ship bottoms for carrying on our suddenly expanded military program became acute, and as an emergency measure the President issued a proclamation which had as its ultimate object the restriction of imports to the barely necessary amounts and diverting the shipping thus saved to urgent war purposes. The task of outlining programs for restriction of imports was delegated to the Shipping Board and Mr. Hurley, who appointed Dr. E. F. Gay to formulate these programs, and Dr. Gay was made a member of the War Trade Board, so that the programs would be carried out under the combined authority of both boards. For the programs of restricted mineral imports Dr. Gay appointed C. K. Leith and J. E. Spurr to form the Committee on Mineral Imports. To this committee Pope Yeatman was added, representing the War Industries Board. One of the problems taken up was that of restricting the importation of chromite from far distant points, such as New Caledonia. A study of the situation was made which involved full conferences with the chromite consumers and the chromite producers, including those of California and Oregon. In 1917 the consumption of chromite in the United States was 127,000 tons of the equivalent of 50% ore, and the consumers advised that the 1918 consumption would be greater. The domestic production in 1917 was 36,552 tons, with 11,407 tons imported from Canada, and no production from Cuba or Brazil.

"Investigations of waste of chromite were made by the Committee on Mineral Imports, with the co-operation of the Interior Department, and the conclusion was reached that if proper conservation measures were taken the consumption for 1918 might be reduced to 130,000 tons. It was the consensus of opinion among the producers that with the proper stimulation the domestic supply for 1918 might be raised to 50,000 tons (on the 50 per cent Cr_2O_3 basis), and the Canadian supply to 15,000 tons, while investigation of the possibilities of Cuba and Brazil led to the belief that from these countries might be obtained approximately 4,000 tons and 22,500 tons respectively (on 50% Cr_2O_3 basis). The consumers finally agreed to this program tentatively and the steel-makers agreed to put into operation the experiment of conservation. The principal consumers advised that they would take

[3]The Mining Congress Journal, November, 1918, pages 416-417.

all the domestic chromite which could be produced, at a good figure, and so advertised publicly, and the government organizations in Washington urged an increase of chromite production in the United States, the universal agreement being that the maximum supply could not exceed the demand. Within a short time, under the stimulus and encouragement of high prices, the production of chromite in California and Oregon assumed absolutely unexpected proportions, new deposits being discovered, especially in Siskiyou County, California. The conservation programs also resulted in enormous savings, the use of chromite as a refractory in steel-making being practically eliminated, with a result that the estimated total consumption for 1918 is about 95,000 tons of 50 per cent chromite, as compared with 127,000 tons in 1917. This unexpected great increase of supply and shrinkage of consumption brought about a condition of oversupply. Somewhat contributing to this was a technical loop-hole in the restriction program. As originally recommended by the Committee on Mineral Imports no exception was to be made to the program on the basis of ballast, or back-haul, but the War Trade Board ruled that these exceptions might be admitted at the discretion of the Ship Control Committee in New York, without referring specific cases back to the War Boards. That is, where a ship coming from New Caledonia needed ballast on account of having a very light main cargo, it might use chromite as ballast instead of taking on rock ballast. Through this loop-hole more chromite was brought in from New Caledonia than was expected.

"It results that the present situation is, that we have no further shortage of chromite to anticipate if things are handled with reasonable judgment. Chromite producers were notified some time ago by the government that it was not encouraging further development, which is indeed the case with manganese and pyrite, for example. Nevertheless, certain producers had gone to heavy expense in the way of equipment and installation and were dismayed at the prospect of not being able to get back their investment. The Geological Survey and the Bureau of Mines have strongly recommended to the War Industries Board that the government should protect the investment of these people, so that they should get their money back, and so bring about the transition from a condition of scarcity to a condition of abundance, and from a period of high prices to a period of lower prices, without serious financial disaster to those who embarked on large enterprises upon government representations. The chairman of the War Industries Board has expressed himself emphatically as strongly in favor of this program, and the question is only as to how to put it into effect. It was believed that this could be done through the Mineral Act, but the legal counsel of the War Industries Board was of the opinion that it could not be taken up under this act, on the ground that there exists at present no shortage in chromite. However, the Bureau of Mines has requested the opinion in this matter of Judge Curtis H. Lindley, of San Francisco, and he is of the opinion that it is entirely within the power of the President to take up the chromite question under this Mineral Act if he so decides."

Following representations of the above-shown conditions to Congress, an amendment to the 'Dent Bill' (H. R. 13274) was passed which provides that the Secretary of the Interior may at his discretion adjust claims of chromite, tungsten, manganese, and pyrite producers. Such claims were to be filed with the War Minerals Relief Commission, Washington, D. C., not later than June 3, 1919. A total of $8,200,000 was made available for such relief of the four minerals named. At present writing (June, 1919), these claims are being investigated and verified.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption. There are two main belts in California yielding this mineral—one, along the Coast Ranges from San Luis Obispo County to the Oregon line, including Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which has been

derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proven to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek near Dunsmuir, from which upwards of 15,000 tons were shipped before it was exhausted. Deposits being worked in Del Norte County during 1918 promised well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918 production came from this source.

Prices and Production.

During 1918 the prices in California on the basis of 40% chromic oxide ranged from $40-$50 per ton f.o.b., with a premium for higher grades and deductions for lower. The producers' reports to the State Mining Bureau indicate an average of approximately $49.35 per ton received for all grades for the year as against $21.60 in 1917, and $14.65 in 1916. From May to September quotations ranged from $1.25 per unit for 38% ore, to $1.50 per unit for 48% and upwards, f.o.b. California points. For the eastern buyer, to these prices freight charges of $11-$16 per ton, had to be added.

Several hundred motor trucks were employed in transporting chromite to the railroad and steamer points. At Hornbrook, Siskiyou County, there were, at times, up to 40 trucks hauling in chrome ore. From one locality, Cecilville, also in Siskiyou County, high-grade chromite was shipped by parcels post on pack mules, 36 miles to Callahan. The mail carrier had 36 mules in service. The postage was $12 per ton to Callahan, from which point auto trucks hauled the ore to the railroad at Gazelle at a cost of $5 per ton.

The distribution of the 1918 product, by counties, was as follows:

County	Tons	Value
Alameda	220	$14,600
Amador	88	4,400
Butte	3,325	134,535
Calaveras	3,830	159,453
Del Norte	7,143	360,485
El Dorado	11,936	674,856
Fresno	2,314	86,181
Glenn	1,129	57,263
Humboldt	370	21,744
Lake	476	24,790
Mendocino	555	44,200
Napa	667	38,432
Nevada	3,328	116,933
Placer	4,963	276,765
San Benito	130	7,000
San Luis Obispo	10,443	539,423
Santa Clara	225	8,968
Shasta	1,423	70,214
Sierra	807	40,012
Siskiyou	6,612	336,588
Sonoma	1,540	73,906
Stanislaus	1,352	56,505
Tehama	3,261	152,291
Trinity	1,814	75,660
Tulare	600	24,000
Tuolumne	4,269	168,693
Colusa, Mariposa, Santa Barbara*	1,135	81,600
Totals	73,955	$3,649,497

*Combined to conceal output of a single mine in each.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874-1886 (San Luis Obispo Co.)	26,028	$329,924	1903	150	$2,250
1887	3,000	40,000	1904	123	1,845
1888	1,500	20,000	1905	40	600
1889	2,000	30,000	1906	317	2,859
1890	3,599	53,985	1907	302	6,040
1891	1,372	20,580	1908	350	6,195
1892	1,500	22,500	1909	436	5,309
1893	3,319	49,785	1910	749	9,707
1894	3,680	39,980	1911	935	14,197
1895	1,740	16,795	1912	1,270	11,260
1896	786	7,775	1913	1,180	12,700
1897			1914	1,517	9,434
1898			1915	3,725	38,044
1899			1916	48,943	717,244
1900	140	1,400	1917	52,379	1,130,298
1901	130	1,950	1918	73,955	3,649,497
1902	315	4,725	Totals	235,480	$6,257,428

GRANITE.

Bibliography: State Mineralogist Reports X, XII, XIII, XIV, XV. Bulletin 38.

In the reports for several years previous to 1916 granite was treated in a subdivision under 'Stone Industry' or under 'Miscellaneous Stone.' We have since rearranged the subjects, somewhat, and now give granite a separate heading, as had previously been done with marble and sandstone. Crushed rock and paving blocks derived from granite quarries are continued under the heading of 'Miscellaneous Stone.'

The output of granite, particularly for building and ornamental purposes, shows a falling off since 1914 from earlier annual amounts. That granite is not used more is probably due to its greater cost as compared to concrete and ornamental brick and tile for building. In 1918 there were no new large pieces of work undertaken. Building operations of all kinds, except those directly connected with war contracts, were largely suspended.

California building granites, particularly the varieties from Raymond, Madera County, and Rocklin, Placer County, are unexcelled by any similar stone found elsewhere.

Granites of excellent quality for building and monumental purposes are also quarried in Riverside and San Diego counties. The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes.

In so far as it has been possible to do so, granite production has been segregated in the following table into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same.

Granite Production, by Counties, for 1918.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			11,360	$26,800					$26,800
Humboldt			60	81					81
Madera	68,551	$36,090			1,856	$928			37,018
Placer			11,568	28,212	2,985	1,880	1,021	$790	30,882
Riverside			3,330	3,176					3,176
Humboldt and Riverside*	220	165							
Madera, San Diego, Tulare*			34,039	40,353					
Humboldt, Madera, San Bernardino*							[1]5,425	1,386	41,904
Totals	68,771	$36,255	60,357	$98,622	4,841	$2,808	6,446	$2,176	$139,861

*Combined to conceal output of a single operator in each.
[1]Includes a stone from San Bernardino County used for a cement-kiln liner.

The value of granite produced, annually since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1904	$467,472
1888	57,000	1905	353,837
1889	1,329,018	1906	344,083
1890	1,200,000	1907	373,376
1891	1,300,000	1908	512,923
1892	1,000,000	1909	376,834
1893	531,322	1910	417,898
1894	228,816	1911	355,742
1895	224,329	1912	362,975
1896	201,004	1913	981,277
1897	188,024	1914	628,786
1898	147,732	1915	227,928
1899	141,070	1916	535,339
1900	295,772	1917	221,997
1901	519,285	1918	139,861
1902	255,239		
1903	678,670	Total	$14,747,609

LIME.

Bibliography: Reports XIV, XV. Bulletin 38.

Lime to the amount of 436,843 barrels, valued at $461,315, was produced from five counties during 1918, as compared with 500,730 barrels, valued at $311,380, in 1917. So far as we have been able to segregate

the data, this figure includes only such lime as is used in building operations. That utilized in sugar making, for smelter flux, and as a fertilizer are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Distribution by counties is shown in the following table:.

County	Barrels	Value
Kern	23,615	$23,615
Santa Cruz	182,083	285,316
San Bernardino, Shasta, Tuolumne*	231,145	152,384
Totals	436,843	$461,315

*Combined to conceal output of a single operator in each.

For table of production by years, see under 'Industrial' limestone, *post*.

MAGNESITE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38. U. S. G. S., Bulletins 355, 540. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr. on H. R. 5218, June 16, 17 and July 17, 1919.

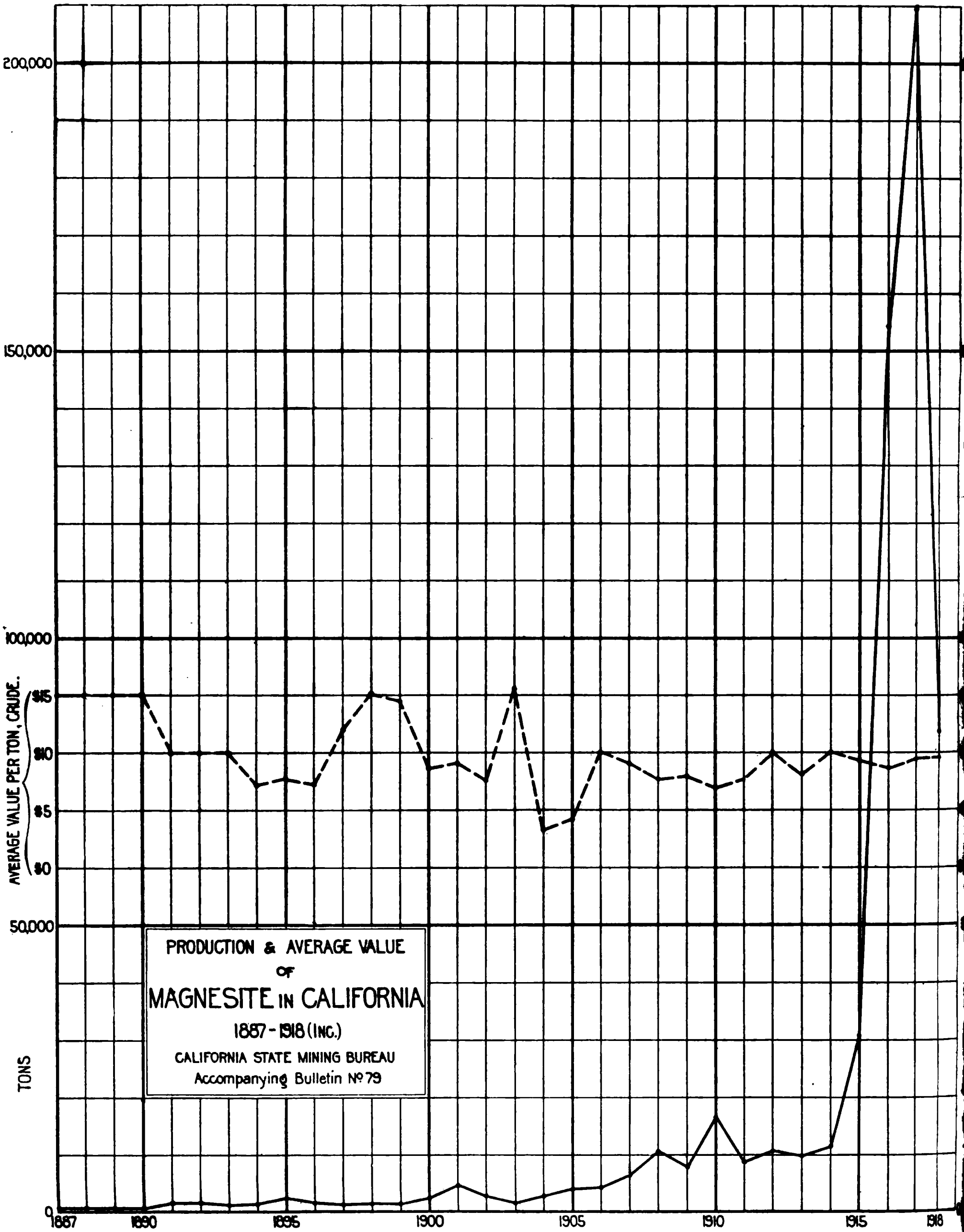
Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2, as calcite has but 44%.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; while the Austrian varieties usually contain iron so that they become brown after calcining. The Washington magnesite, one of the most recent developments, resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California, the known deposits are mostly in the metamorphic rocks of the Coast Ranges and Sierra Nevada Mountains, being associated with serpentine areas. The notable exceptions are two sedimentary deposits, one at Bissell in Kern County, and one at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; but, thus far, only one small shipment for experimental purposes has been sent out from the Afton property.

The Washington deposits are stated to be associated with extensive strata of dolomitic limestones. The magnesite there appears to contain


PRODUCTION & AVERAGE VALUE
OF
MAGNESITE IN CALIFORNIA
1887-1918 (INC.)
CALIFORNIA STATE MINING BUREAU
Accompanying Bulletin Nº 79
TONS
AVERAGE VALUE PER TON, CRUDE.
200,000
150,000
100,000
50,000
0
$15
$10
$5
$0
1887
1890
1895
1900
1905
1910
1915
1918

more iron than most of the California mineral, which makes it desirable for the steel operators. However, the experience of the past three years has proven that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine near Preston in Sonoma County, and the White Rock Mine at Pope Valley, Napa County.

Uses.

The principal uses at the present time include: refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work, it has proven particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes, the magnesite is 'dead burned'—*i. e.,* all or practically all of the CO_2 is expelled from it. For cement purposes, it is left 'caustic'—*i. e.,* from 5% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours as a tough, seamless surface.

It is stated that some metallic magnesium has been prepared electrolytically at Niagara Falls, from magnesite (see also Magnesium Chloride, under 'Salines,' *post*).

For refractory purposes, the calcined magnesite is largely made up into bricks, similar to fire-brick for furnace linings. It is also used un-consolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure, magnesia cannot be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attaching the fire-brick of the hearth.

Imports, and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 tons in 1913; 144,747 tons in 1914; and 63,347 tons in 1915; most of it coming from Austria-Hungary. For the same years, the production of crude (about

two tons of crude ore required to yield one ton of the calcined) magnesite in California (the sole producer for those years, in the United States) was: 9,632 tons, 1913; 11,438 tons, 1914; 30,721 tons, 1915. For 1916 the California output leaped to 154,052 tons of crude and to 209,648 tons in 1917. Shipments were begun from Washington late in 1916.

A bill (H. R. 5218) has been introduced in Congress to provide for an import duty of $\frac{3}{4}$¢ per pound on crude magnesite, $1\frac{1}{4}$¢ per pound on calcined, and 25% *ad valorem* on magnesite brick. The House Committee on Ways and Means held a series of hearings on this bill, June 16, 17 and July 17, 1919, at which much valuable data relative to American magnesite was presented.[1]

Previous to the war, Austrian magnesite was sold at Chester, Pa., and Baltimore, Md., at $16.15 per net ton. The rail rate from the mines to Triest is stated to have been $4.00 per ton, and the ocean rate, at times as low as $2.00 per ton, as it came over largely in ballast.

Sworn statements of costs were presented by various American operators at the above-mentioned hearings. Washington costs were shown to be from $21 to $25 per ton of calcined ready for shipment. The following California costs of calcined ore, f.o.b., shipping point, were given: Porterville Magnesite Co., $28.43 per ton; Tulare Mining Co., $24.97; Western Magnesite Development Co., $24.16; White Rock Mine, $28.22. The average cost per ton for the six principal producers in Washington and California was $25.13 per ton. Add to this the transcontinental freight rate of $16.07, and we have a cost of $41.20 for American magnesite at Atlantic ports.

"CALCINING CAPACITY OF THE UNITED STATES.[2]

"The capacity of the calcining plants of California is estimated at 350 to 400 tons daily or 10,000 to 12,000 tons monthly. In Washington considering one plant alone, the Northwest Magnesite Co., there is a calcining capacity of 10,000 tons per month, making in all a capacity of 20,000 tons per month, or 240,000 tons per year, which is far more than ample for the needs of the United States.

"QUANTITY OF MAGNESITE USED PER TON OF STEEL.

"Prior to the war between 6 and 14 pounds of magnesite was used per ton of steel, according to estimates of several prominent eastern steel manufacturers. The quantity used was cut in half during the war owing to a greater measure of economy and the substitution for magnesite of dead-burned dolomite. About 3 to 7 pounds, or an average of 5 pounds per ton of steel, was used during 1917, which quantity may be considered approximately that now used. Thus, it will be seen that the quantity of magnesite now consumed per ton of steel is only 50 per cent of what it was prior to the war.

"The cost of magnesite per ton of steel is small and this spring with the price of magnesite brick at $450 per thousand and with grain magnesite at Chester, Pa., at $48.50 per ton, the cost of magnesite per ton of steel on the basis of all brick was about $22\frac{1}{2}$ cents, and on the basis of grain magnesite, $12\frac{1}{2}$ cents. The cost of magnesite per ton of steel must lie somewhere between these limits and, assuming the use of half brick and half grain, would not be far from 17 to 18 cents, under the prices which prevailed this spring. On the basis of two-thirds brick and one-third grain the cost would be about 19 cents. These prices have been abnormally high and it is probable that 8 or 9 cents per ton of steel is nearer the truth for normal prewar conditions, but greater economy in the use of magnesite, and especially in the use of dead-burned grain and the substitution therefor of dead-burned dolomite have tended to offset the high war prices

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[1]Magnesite. Hearings before the Committee on Ways and Means, House of Representatives, on H. R. 5218, June 16 and 17, 1919; Part II, July 17, 1919. Gov't Printing Office, 1919.
[2]*Op. cit.*, pp. 218, 219.

"Dead-burned dolomite has been used in the past as a refractory in repairing furnace linings, but statistics showing the extent of this application are lacking. According to data of the United States Geological Survey 340,000 tons of dead-burned dolomite was marketed in 1917—figures which indicate at least an important degree of competition with grain magnesite."

* * * * * * *

"FREIGHT RATES AND COSTS AT EASTERN POINTS.

"The recent price for Washington calcined magnesite has been $32.50 per ton at Chewelah, Wash. Little or no California magnesite has recently come East for refractory purposes, but some has been shipped to Chicago for plastic purposes. The latter involves very careful selection and fine grinding and is put in bags. Consequently, it is much higher in price than that used for refractory purposes, and the price varies with the care exercised in preparation. Magnesite brick this spring at Chester, Pa., were $90 per ton, or $450 per thousand, and this price is still quoted in some of the latest technical journals.

"Freight rates plus war tax to Pittsburg from California and Washington points are $14.21 per ton and to Chester, Pa., $16.07 per ton, making the total cost per ton of grain magnesite at these points $46.71 and $48.57, respectively. The freight rate on calcined Canadian magnesite to Pittsburg, Pa., is about $8.50 which is just about half of what it was from the western points to that city.

"LOCATION OF PRINCIPAL REFRACTORY COMPANIES.

"There are undoubtedly many small manufacturers of magnesite brick scattered over the country. The great bulk of the brick is, however, turned out by 9 to 10 concerns, and of these 4 or 5 companies produce most of the brick manufactured. These largest magnesite brick concerns are all in the eastern part of the United States, from the Mississippi Valley to Pennsylvania points. The plant of the Harbison-Walker Co., where magnesite brick is made, is at Chester, Pa.; that of the American Refractories Co. is at Baltimore, Md.; that of the General Refractories Co. is at Bolivar, Pa.; that of Federal Refractories Co. is at Lock Haven, Pa. Other plants are located at Johnstown, Pa., and St. Louis, Mo., Salt Lake City, Utah, and at Seattle and Spokane, Wash. Of course, grain magnesite for furnace use may be shipped direct to the consumers; it is only the material sold in the form of brick that has to go into the trade by way of brick-making establishments."

Some conflicts arose in the testimony as to the relative qualities of the American and foreign magnesite; but the more reliable data presented indicated that the American article is equal in quality to any other.

Output and Value.

In considering mineral production the value of the crude material is used as far as practicable. Magnesite presents a peculiar example of a material which previous to the present activity was seldom handled on the market in the crude state. It is ordinarily calcined and ground before being considered marketable. From 2 to 2½ tons of the crude material are mined to make one ton of the calcined. In the earlier reports an arbitrary value for the crude material at the mine was calculated from the above on the basis of the calcined value, there having been very little product shipped crude. On the contrary, however, considerable tonnages were in 1916–1918 (inc.) shipped in the crude state, contracted for at prices ranging from $7 to $14 per ton, f.o.b. rail points, or an average of about $9.55 per ton, for 1918. This is the basis of the valuation used herein.

The production of crude magnesite in California during the year 1918, totaled 83,974 tons valued at $803,492 f.o.b. rail-shipping point. This is considerably less than half the 1917 output of 209,648 tons and $1,976,227. This is due in large part, as indicated in preceding paragraphs, to the development of the deposits in the state of Washington.

They, in turn, have been nearly all (if not entirely) closed down, according to recent reports, by the importation of magnesite from eastern Canada, which is closer to the steel-producing centers, and by the expectation of receiving ore from Europe. The Canadian magnesite, though containing an objectionable percentage of lime, is being used on account of being cheaper and nearer at hand. Very likely importations from Austria and Greece will be resumed before long.

It looks as if the main hope for the future for California magnesite lies in the development of the plastic business in the territory west of the Rocky Mountains; and in the manufacture of refractory brick to be utilized mainly by the copper and lead smelters in the same district. It is possible that, after ocean shipping has resumed its normal routes, California magnesite may be sent via the Panama Canal to the Atlantic seaboard; but, on account of our higher production costs, it is difficult to see how we can compete with the Grecian article at Atlantic ports.

Three new plants were reported early in 1919 as preparing to make refractory brick here from California magnesite, one each at Porterville, Los Angeles, and Richmond. For at least two years past, the output of the Refractory Magnesite Company at Preston, Sonoma County, has been turned into bricks at the plant of the Stockton Fire and Enamel Brick Company, at Stockton. The mineral from this property is a natural ferro-magnesite and has found a ready market for refractory purposes. That from the White Rock Mine in Napa County also carries some iron.

"NEEDS FOR STANDARDIZING THE DOMESTIC PRODUCT.[a]

"One of the most important factors in the success of Austrian magnesite has been the careful standardization of the finished product attained only by careful selection and preparation of the raw material, and skillful burning, whereby a product of uniform quality has been assured. Uniformity and close adherence to specifications undoubtedly have been important factors in the growth of both Austrian and Grecian business in the United States. These factors are called to the attention of certain of our domestic producers because laxity on the part of a few of them in these respects has caused some dissatisfaction among certain domestic consumers, and unfortunately an unsympathetic attitude toward them, at the present time.

"There were undoubtedly extenuating circumstances during the war period, among which was the sudden and urgent demand caused by the complete cutting off of the Austrian and Grecian product, together with a certain degree of inexperience in the business. The importance to our own producers of careful selection and care in burning can not be over-emphasized in the building up and maintenance of the domestic industry, and it is believed that the domestic producers are alive to the situation."

In 1918, for the first time since Tulare County became an important producer of this mineral, it was surpassed in tonnage output for the year. Napa County leads with 29,163 tons, against 28,826 tons from Tulare, followed by Santa Clara with 9,746 tons. Approximately 40,000 tons were reported as shipped calcined.

Production of crude magnesite for 1918, by counties, is given in the following table, with total crude value:

[a]Phalen, W. C., Magnesite. In "Excerpts from monthly reports on minerals investigations in the Bureau of Mines, Department of the Interior," February, 1919.

County	Tons	Value
Fresno	1,795	$16,151
Napa	29,163	263,367
San Benito	5,340	48,060
Santa Clara	9,746	121,872
Sonoma	4,110	40,010
Stanislaus	2,024	18,038
Tulare	28,826	269,748
Kern, Riverside, San Bernardino*	2,970	26,246
Totals	83,974	$803,492

*Combined to conceal output of a single producer in each.

Annual production for California, amount and value, since 1887, is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1904	2,850	$9,298
1888	600	9,000	1905	3,933	16,221
1889	600	9,000	1906	4,032	40,320
1890	600	9,000	1907	6,405	57,720
1891	1,500	15,000	1908	10,582	80,822
1892	1,500	15,000	1909	7,942	62,588
1893	1,093	10,930	1910	16,570	113,887
1894	1,440	10,240	1911	8,858	67,430
1895	2,200	17,000	1912	10,512	105,120
1896	1,500	11,000	1913	9,632	77,056
1897	1,143	13,671	1914	11,438	114,380
1898	1,263	19,075	1915	30,721	283,461
1899	1,280	18,480	1916	154,052	1,311,893
1900	2,252	19,333	1917	209,648	1,976,227
1901	4,726	43,057	1918	83,974	803,492
1902	2,830	20,655			
1903	1,361	20,515	Totals	597,637	$5,389,871

MARBLE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38. U. S. Bur. of M., Bull. 106.

Marble is widely distributed in California; and in a considerable variety of colors and grain. During 1918, the production amounted to 17,548 cubic feet, valued at $49,898, from one operator each in Los Angeles, San Bernardino and Solano counties, and two in Tuolumne. The Solano County stone is onyx marble, and that from Los Angeles is serpentine from Santa Catalina Island. Both varieties were used for decorative purposes; and some of the serpentine was also utilized for electric switchboard construction. This shows a decrease both in amount and value from the previous year. This is considerably below what might be considered the normal output of former years, and certainly far below our possibilities.

The decrease in output of marble in recent years is probably due in part to the fact that foreign, eastern and Alaskan marbles are landed here by water cheaper than much of our local stone can be put on the

market, on account of our higher labor costs and transportation difficulties, though California has many beautiful and serviceable varieties. It is also due in part to the general curtailment of building activity on account of the war conditions.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amount were preserved:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1904	55,401	$94,208
1888		5,000	1905	73,303	129,450
1889		87,030	1906	31,400	75,800
1890		80,000	1907	37,512	118,066
1891		100,000	1908	18,653	47,665
1892		115,000	1909	79,600	238,400
1893		40,000	1910	18,960	50,200
1894	38,441	98,326	1911	20,201	54,103
1895	14,864	56,566	1912	27,820	74,120
1896	7,889	82,415	1913	41,654	113,282
1897	4,102	7,280	1914	25,436	48,832
1898	8,050	23,594	1915	22,186	41,518
1899	9,682	10,550	1916	25,954	50,280
1900	4,103	5,891	1917	24,755	62,950
1901	2,945	4,630	1918	*17,428	49,898
1902	19,305	37,616			
1903	84,624	97,354	Total value		$2,055,024

*Includes onyx and serpentine.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII, XIII, XIV. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been no production reported since the year 1896, until 1918. Some stone was shipped in 1918 from the Tolenas Springs onyx marble deposit in Solano County, and utilized for decorative purposes. As there was but a single operator, the figures are combined with those of the marble output.

Production by years was as follows:

Year	Value	Year	Value
1887	$900	1894	$20,000
1888	900	1895	12,000
1889	900	1896	24,000
1890	1,500	1918	*
1891	2,400		
1892	1,800	Total	$91,400
1893	27,000		

*See under Marble.

SANDSTONE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as

well as the popularity of a lighter colored building stone, has retarded this branch of the mineral industry very seriously during recent years. In 1918 two counties—Santa Barbara and Ventura—turned out 900 cubic feet, valued at $400, which is considerably less than former years. The main feature of the loss since 1914 is the closing of the well-known Colusa quarries, on account of the competition of lighter colored materials.

Amount and value, as far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887	----------	$175,000	1904	363,487	$567,181
1888	----------	150,000	1905	302,813	483,268
1889	----------	175,598	1906	182,076	164,068
1890	----------	100,000	1907	159,573	148,148
1891	----------	100,000	1908	93,301	55,151
1892	----------	50,000	1909	79,240	37,032
1893	----------	26,314	1910	165,971	80,443
1894	----------	113,592	1911	255,313	127,314
1895	----------	35,373	1912	66,487	22,574
1896	----------	28,379	1913	62,227	27,870
1897	----------	24,086	1914	111,691	45,322
1898	----------	46,384	1915	63,350	8,438
1899	56,264	103,384	1916	17,270	10,271
1900	378,468	254,140	1917	31,090	7,074
1901	266,741	192,132	1918	900	400
1902	212,123	142,506			
1903	353,002	585,309	Total value	----------	$4,086,751

SERPENTINE.

Bibliography: Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the first recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures are combined with those of marble output.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905	----------	----------
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[1]	[1]
1900	350	2,000	1918	[2]	[2]
1901	89	890			
1902	512	5,065	Totals	12,347	$33,259
1903	99	800			

[1]Under 'Unapportioned.'
[2]See under Marble.

SLATE.

Bibliography: Report XV. Bulletin 38.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, there being none between that year and 1915. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The size of the pieces of slate making up a square ranges from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. It is worth $3.50 to $10 per square, f.o.b. quarry, depending on quality. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1905	4,000	$40,000
1890	4,000	24,000	1906	10,000	100,000
1891	4,000	24,000	1907	7,000	60,000
1892	3,500	21,000	1908	6,000	60,000
1893	3,000	21,000	1909	6,961	45,660
1894	1,800	11,700	1910	1,000	8,000
1895	1,350	9,450	1911		
1896	500	2,500	1912		
1897	400	2,800	1913		
1898	400	2,800	1914		
1899	810	5,900	1915	1,000	5,000
1900	3,500	26,250	1916		
1901	5,100	38,250	1917		
1902	4,000	30,000	1918		
1903	10,000	70,000			
1904	6,000	50,000	Totals	88,821	$676,399

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38.

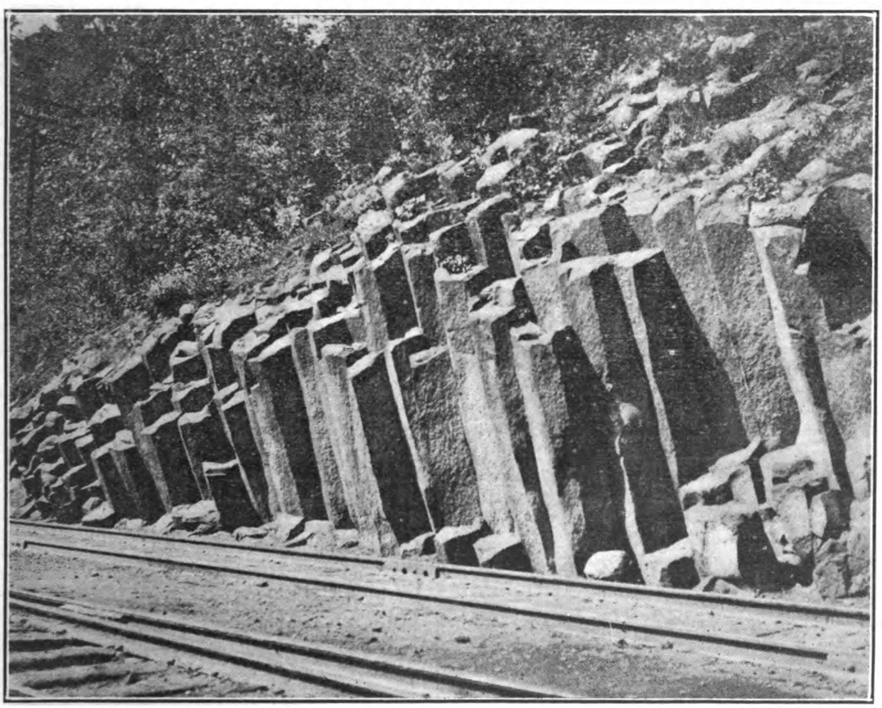
Miscellaneous stone is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer. Thus it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. In so far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will

be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept. Estimates have been made for some of this output, based on the mileage of roads repaired.

For the year 1918 miscellaneous stone shows a decrease in total value from the preceding year, of $230,610. The 1918 total was $3,404,157 as compared with $3,634,767 for 1917; $4,171,519 for 1916, and $5,186,743 for 1913. This is a much better showing than had been anticipated, on account of the curtailment of general construction work due to the war-time situation and regulations, and to freight car embargoes.

The outlook for the current year, 1919, is very encouraging. Besides a marked revival in general building operations, an extensive program



Columnar basalt at Dunsmuir, Siskiyou County. Basalt is an excellent material as crushed rock for macadam and concrete.

of highway construction is under way: not only by the federal and state departments, but by many of the counties of California, as well.

The recent freight rate reductions of 10 cents a ton on road materials for use by federal, state or municipal governments will not doubt also be an important factor in stimulating this work.

In 1918, as has been the case for a number of years past, Los Angeles County led all others by a wide margin, with an output valued at $547,190; followed by Contra Costa, second, with $324,884; Alameda, third, $311,320; Sacramento, fourth, $262,689; and Fresno, fifth, $244,647.

Paving Blocks.

The paving block industry has decreased materially of recent years, because of the increased construction of smoother pavements demanded by motor vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte; while those from all the other counties shown in the tabulation, are of granite.

Paving Block Production, by Counties, for 1918.

County	Amount M	Value
Riverside	41	$1,980
Sonoma	300	13,500
Placer and San Diego*	31	1,520
Totals	372	$17,000

*Combined to conceal output of a single producer in each.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M.	Value	Year	Amount M.	Value
1887	*10,000	$350,000	1904	3,977	$161,752
1888	10,500	367,500	1905	3,408	134,347
1889	7,303	297,236	1906	4,203	173,432
1890	7,000	245,000	1907	4,604	199,347
1891	5,000	150,000	1908	7,660	334,780
1892	*3,000	96,000	1909	4,503	199,803
1893	2,770	96,950	1910	4,434	198,916
1894	2,517	66,981	1911	4,141	210,819
1895	2,332	73,338	1912	11,018	578,355
1896	4,161	77,584	1913	6,364	363,505
1897	1,711	35,235	1914	6,053	270,598
1898	1,144	21,725	1915	3,285	171,092
1899	305	7,861	1916	1,322	54,362
1900	1,192	23,775	1917	938	38,567
1901	1,920	41,075	1918	372	17,000
1902	3,502	112,437			
1903	4,854	134,642	Totals	135,483	$5,304,014

*Figures for 1887–1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, there has been a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold-dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, has been in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which came from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly basalt and diabase, with an occasional felsite and flint pebble. There is a tough, black basalt which is stated to be giving satisfactory results. The Fresno County pebbles are selected from the gravel beds of the San Joaquin River near Friant. Shipments have been made to metallurgical plants in California, Nevada, Montana, and Utah.

Resumption of imports is expected in 1919, but the California pebbles may still continue to supply a part of the local demand.

Grinding Mill Pebbles Production, for 1918.

County	Tons	Value
Fresno and San Diego*	8,628	$61,268

*Combined to conceal output of a single producer in Fresno County.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
Totals	50,650	$262,183

Sand and Gravel Production, by Counties, for 1918.

County	Tons	Value
Alameda	[1]548,491	$222,675
Amador	2,000	1,500
Calaveras	700	420
Colusa	1,600	700
Contra Costa	24,209	7,420
Del Norte	20,000	8,000
El Dorado	8,500	5,500
Fresno	59,298	22,898
Glenn	212,017	32,436
Humboldt	61,631	39,691
Imperial	54,872	8,570
Inyo	1,333	1,000
Lake	1,500	1,000
Los Angeles	943,742	280,300
Madera	1,600	300
Marin	1,900	390
Mariposa	500	200
Mendocino	13,333	5.000
Merced	11,100	4,500
Monterey	[2]87,251	49,697
Napa	172,829	77,707
Nevada	500	200
Orange	9,200	1,560
Placer	5,850	2,500
Plumas	500	200
Sacramento	119,512	53,683
San Benito	29,000	9,800
San Bernardino	12,000	7,685
San Diego	[3]107,315	85,645
San Francisco	7,809	5,257
San Joaquin	117,874	42,767
San Luis Obispo	15,500	5,450
San Mateo	9,743	6,257
Santa Barbara	8,067	3,875
Santa Clara	161,871	78,085
Santa Cruz	[4]7,567	3,065
Shasta	15,000	7,000
Siskiyou	33,767	11,055
Solano	3,000	1,800
Sonoma	72,638	33,677
Stanislaus	53,322	38,764
Tehama	2,667	2,500
Tulare	135,082	34,556
Tuolumne	1,000	500
Ventura	105,000	50,400
Yolo	10,830	17,915
Yuba	161,459	42,691
Butte, Kern, Riverside, Trinity*	69,532	12,852
Totals	3,504,011	$1,329,643

*Combined to conceal output of a single operator in each.
[1]Includes moulding sand.
[2]Includes moulding, building, and roofing sand.
[3]Includes foundry moulding sand.
[4]Includes chicken grit.

Crushed Rock Production, by Counties, for 1918.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	16,478	$7,954			82,060	$76,821	5,000	$3,750	103,538	$88,525
Amador							9,000	5,000	9,000	5,000
Contra Costa	53,674	35,433	14,033	$13,683	200,169	168,085	156,206	100,263	424,082	317,464
Fresno	23,316	12,433			256,453	160,597	73,799	47,969	353,568	220,999
Humboldt	5,585	11,391							5,585	11,391
Inyo					2,667	4,000			2,667	4,000
Lassen	1,067	800							1,067	800
Los Angeles	79,028	112,275			65,860	47,175	204,627	107,440	349,515	266,890
Marin			1,928	1,708					1,928	1,708
Mariposa	500	200							500	200
Modoc	500	200							500	200
Napa	8,469	4,835			375	402			8,844	5,237
Nevada	3,000	1,200							3,000	1,200
Placer	500	200	2,748	1,296					3,248	1,496
Plumas	30,100	7,550							30,100	7,550
Riverside	77,915	38,836	16,930	9,393	218,202	76,225	250	928	313,297	125,382
San Bernardino			60,040	30,768					60,040	30,768
San Diego			5,444	4,590					5,444	4,590
San Francisco	1,200	300			11,862	10,906			13,062	11,206
San Luis Obispo							1,000	650	1,000	650
San Mateo	19,390	19,764			6,744	7,511	750	632	26,884	27,907
Santa Barbara	5,267	7,738							5,267	7,738
Santa Clara	49,794	18,984							49,794	18,984
Santa Cruz					1,822	2,154	[1]972	3,888	2,794	6,042
Siskiyou	29,735	13,533							29,735	13,533
Sonoma	13,996	8,329	179	104					14,175	8,433
Tulare			2,725	636					2,725	636
Ventura	5,000	2,500							5,000	2,500
Butte, El Dorado, Imperial, Merced, Monterey, San Benito, Tulare, Tuolumne, Yuba*	240,209	109,293								
Alameda, Imperial, Madera, Sacramento, Trinity*			95,867	24,730						
El Dorado, Imperial, Marin, Merced, San Benito, San Diego, San Joaquin*					253,782	181,363				
Butte, Marin, Merced, Sacramento, San Bernardino, San Diego, Solano, Sonoma, Tulare*							720,916	489,831	1,310,774	805,217
Totals	664,723	$413,748	199,894	$86,908	1,099,996	$735,239	1,172,520	$760,351	3,137,133	$1,996,246

*Combined to conceal output of a single operator in each. [1]Includes chicken grit.

A comparison of the table of annual productions of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business was coincident with the rapid development of the cement industry from the year 1902.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1907	2,288,888	$1,915,015
1894	661,900	664,838	1908	3,998,945	3,241,774
1895	1,254,688	1,095,939	1909	5,531,561	2,708,326
1896	960,619	839,884	1910	5,827,828	2,777,690
1897	821,123	600,112	1911	6,487,223	3,610,357
1898	1,177,365	814,477	1912	8,044,937	4,532,598
1899	964,898	786,892	1913	9,817,616	4,823,056
1900	789,287	561,642	1914	9,288,397	3,960,973
1901	530,396	641,037	1915	10,879,497	4,609,278
1902	2,056,015	1,249,529	1916	9,951,089	4,009,590
1903	2,215,625	1,673,591	1917	8,069,271	3,505,662
1904	2,296,898	1,641,877	1918	6,641,144	3,325,889
1905	2,624,257	1,716,770			
1906	1,555,372	1,418,406	Totals	105,105,939	$57,181,277

Total Value of Production of 'Miscellaneous Stone' (Crushed Rock, Sand, Gravel, Paving Blocks and Grinding Mill Pebbles), by Counties, for 1918.

County	Value
Alameda	$311,320
Amador	6,500
Butte	77,822
Calaveras	420
Colusa	700
Contra Costa	324,884
Del Norte	8,000
El Dorado	20,500
Fresno	244,647
Glenn	32,436
Humboldt	51,082
Imperial	34,787
Inyo	5,000
Kern	311
Lake	1,000
Lassen	800
Los Angeles	547,190
Madera	1,540
Marin	89,458
Mariposa	400
Mendocino	5,000
Merced	32,500
Modoc	200
Monterey	52,697
Napa	82,944
Nevada	1,400
Orange	1,560
Placer	4,266
Plumas	7,750
Riverside	127,962
Sacramento	262,689
San Benito	103,295
San Bernardino	48,451
San Diego	184,158
San Francisco	16,463
San Joaquin	47,085
San Luis Obispo	6,100
San Mateo	34,164
Santa Barbara	11,613
Santa Clara	111,860
Santa Cruz	9,107
Shasta	7,000
Siskiyou	24,588
Solano	30,124
Sonoma	148,347
Stanislaus	38,764
Tehama	2,500
Trinity	1,513
Tulare	125,407
Tuolumne	1,700
Ventura	52,900
Yolo	17,915
Yuba	43,338
Total	$3,404,157

CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: Reports XIV, XV. Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917.

The following mineral substances have been arbitrarily arranged under the general heading of Industrial Materials, as distinguished from those which have a clearly defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large and with increasing transportation, and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is certainly promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely varying amounts of a certain material produced from year to year, but in widely varying prices of the same material. Furthermore, the quality of this general class of material will be found to fluctuate, even in the same deposit. The war in Europe has affected some of these items, but not to the striking degree that it has the metal markets.

The more important of these minerals thus far exploited, so far as shown by annual value of the output, are limestone, mineral water, pyrite, pottery clays, and diatomaceous earth.

The following summary shows the value of the industrial materials produced in California during the years 1917-1918, with increase or decrease in each instance:

Metal	1917		1918		Increase+ Decrease—
	Amount	Value	Amount	Value	Value
Asbestos	136 tons	$10,225	229 tons	$9,903	$322—
Barytes	4,420 tons	25,633	100 tons	1,500	24,133—
Clay (pottery)	166,298 tons	154,602	112,423 tons	166,788	12,186+
Dolomite	27,911 tons	66,416	24,560 tons	79,441	13,025+
Feldspar	11,792 tons	46,411	4,132 tons	22,061	24,350—
Fluorspar	*	*	*	*	* +
Fuller's earth	220 tons	2,180	87 tons	333	1,847—
Gems		3,049		650	2,399—
Graphite	*	*	*	*	* —
Gypsum	30,825 tons	56,840	19,695 tons	37,176	19,664—
Infusorial and diatomaceous earths	24,801 tons	127,510	85,963 tons	189,459	61,949+
Limestone	237,279 tons	356,396	208,566 tons	456,258	99 862+
Lithia	880 tons	8,800	4,111 tons	73,998	65,198+
Mineral paint	520 tons	2,700	728 tons	4,738	2,038+
Mineral water	1,942,020 gals.	340,666	1,808,791 gals.	375,650	34,984+
Pumice and volcanic ash	525 tons	5,295	2,114 tons	28,669	23,374+
Pyrite	111,325 tons	323,704	128,329 tons	425,012	101,308+
Silica (sand and quartz)	19,376 tons	41,166	23,257 tons	88,930	47,764+
Soapstone and talc	5,267 tons	45,279	11,760 tons	85,534	40,255+
Strontium	3,050 tons	37,000	2,900 tons	33,000	4,000—
Fluorspar and graphite*		5,612		4,104	1,508—
Totals		$1,659,484		$2,083,204	
Net increase					$423,720+

*Combined to conceal output of a single operator in each.

ASBESTOS.

Bibliography: State Mineralogist Reports XII, XIII, XIV. Bulletin 38. Canadian Dept. of M., Mines Branch Bull. 69.

Though asbestos of various grades is known in several localities in California, the production thus far is still small. For the year 1918 there were marketed 229 tons valued at $9,903. This was principally from Nevada County, with smaller amounts from Alameda and Calaveras. Some small shipments of spinning fibre were sent East; but the main part of the output was utilized locally in magnesite-cement stucco, steam-pipe covering, and flooring.

The Nevada County material yields a good proportion of medium-length chrysotile with some high-grade spinning fibre. The Sierra Asbestos Company has opened up a promising deposit there, and is milling its rock in an old 20-stamp gold-mill converted to their purposes, to which fiberizing machinery has been added. They report prospects for an increased output in 1919.

The bulk of the world's supply of this mineral comes from Canada; and Canadian asbestos, so far, leads in length of fibre as well as in quantity.

Classification and Characteristics.

The word asbestos (derived from the Greek, meaning incombustible) as used here includes several minerals, from a strictly mineralogical standpoint. There are two main divisions, however; amphibole and chrysotile. The fibrous varieties of several of the amphiboles (silicates chiefly of lime, magnesia and iron), notably tremolite and actinolite, are called asbestos. Their fibres usually lie parallel to the fissures containing them. Amphibole asbestos possesses high refractory properties, but lacks strength of fibre, and is applicable principally for covering steam pipes and boilers. Chrysotile, a hydrous silicate of magnesia, is a fibrous form of serpentine, and often of silky fineness. Its fibres are formed at right angles to the direction of the fissures containing them. Chrysotile fibres, though short, have considerable strength and elasticity, and may be spun into threads and woven into cloth. To bring the highest market price asbestos must needs have a combination of properties, *i. e.*, length and fineness of fibre, tensile strength and flexibility—all combined with infusibility. Of these qualities the most important are toughness and infusibility, and determination of the same can only be made by practical tests or in the laboratory.

Asbestos, roughly speaking, was worth from $20 to $200 per ton, before the war. Under the stimulus of war conditions, the demand has caused a material increase in prices. The poorer grades which are unsuitable for weaving and which, of course, command the lower prices, are used in the manufacture of steam packing, furnace linings, asbestos brick, wall plasters, paints, tiling, asbestos board, shingles, insulating material, magnesite-stucco, etc. The better grades are utilized in the manufacture of tapestries of various kinds, fireproof theater curtains, cloth, rope, etc.

A very important development of the asbestos industry is the rapidly increasing demand for the lower grade material, on account of the numerous diversified uses to which asbestos products are being put, in almost every branch of manufacture. This fact means that many deposits of asbestos will become commercially important even though the grade of the material is far from the best.

It has been found that not only does an asbestos wall-plaster render the wall so covered impervious to heat, but that in rooms which have given forth an undesirable echo this evil has been absolutely removed. Asbestos pulp mixed with magnesite-cement has been experimented with; and roofing, flooring, and other building material of the most satisfactory sort has been manufactured therefrom.

Value and Production.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1904	10	$162
1888	30	1,800	1905	112	2,625
1889	30	1,800	1906	70	3,500
1890	71	4,260	1907	70	3,500
1891	66	3,960	1908	70	6,100
1892	30	1,830	1909	65	6,500
1893	50	2,500	1910	200	20,000
1894	50	2,250	1911	125	500
1895	25	1,000	1912	90	2,700
1896	-------	----------	1913	47	1,175
1897	-------	----------	1914	51	1,530
1898	10	200	1915	143	2,860
1899	30	750	1916	145	2,380
1900	50	1,250	1917	136	10,225
1901	110	4,400	1918	229	9,903
1902	-------	----------			
1903	-------	----------	Totals	2,145	$101,460

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV. Bulletin 38.

The output of crude barytes during 1918 was 100 tons, valued at $1,500, as compared with the 1917 production of 4,420 tons, worth $25,633. This mineral is ordinarily sorted and ground before being put on the market, and in this prepared condition brings from $15 to $25 per ton. The principal use of barytes is in the paint industry; also in certain rubber articles. For the former purpose, the material should show pure white after grinding. Lithopone is a chemically prepared white pigment containing about 70% barium sulphate and 30% zinc sulphide, and is one of the principal constituents of 'flat' wall paints now so extensively used in office buildings and hospitals, replacing both paper and calcimine wall finishes. Minor uses are in tanning of leather, manufacture of paper and rope, and sugar refining.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, San Bernardino, and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part, witherite (barium carbonate, $BaCO_3$). The 1915 output was the first commercial production of the carbonate in the United States, of which we have record. In 1916, output began from a new deposit opened up on Fremont's Peak, Monterey County, near the line of San Benito County.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

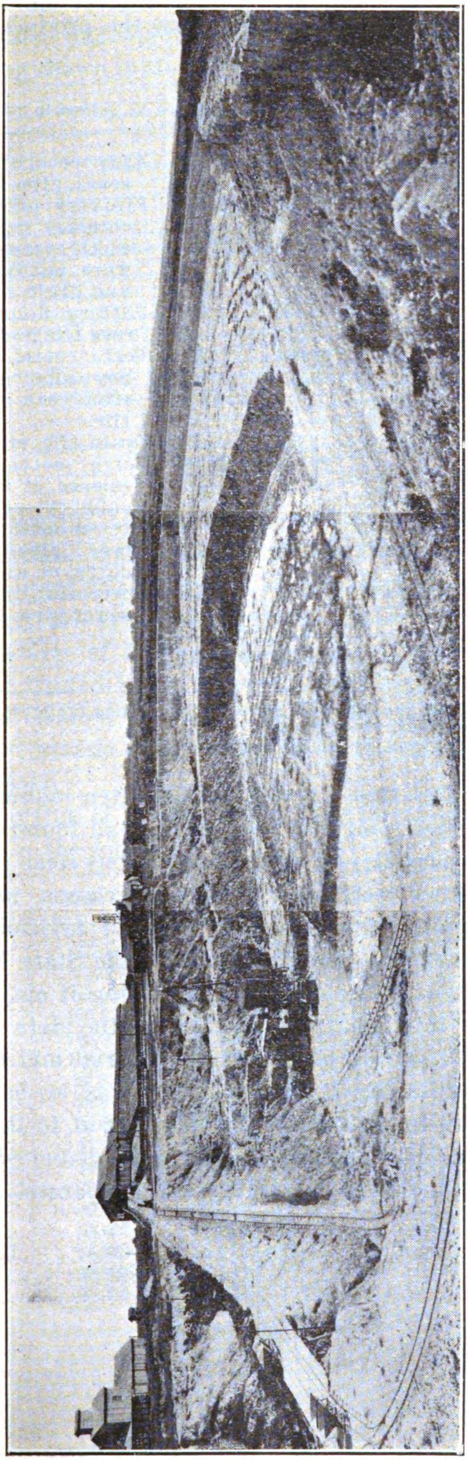
Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1916	1,606	$5,516
1911	309	2,207	1917	4,420	25,633
1912	564	2,812	1918	100	1,500
1913	1,600	3,680			
1914	2,000	3,000	Totals	11,869	$50,608
1915	410	620			

CLAY—POTTERY.

Bibliography: State Mineralogist Reports I, IV, IX, XII, XIII, XIV, XV. Bulletin 38.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. In this report pottery clay refers to all clays used in the manufacture of red and brown earthenware, flower pots, ornamental tiling, architectural terra cotta, sewer pipe, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form, or whether it was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and building blocks.

During 1918 a total of 31 producers in 10 counties reported an output of 112,423 tons of clay, having a spot value of $166,788 for the crude material, at the pits, as compared with the 1917 production of 166,298 tons worth $154,602.



Pit of the Lincoln Clay Products Company, near Lincoln, Placer County.

A tabulation of the direct returns from the producers, by counties, for the year 1918, is shown herewith:

County	Tons	Value	Used in manufacture of—
Alameda	2,675	$3,850	Architectural terra cotta and sewer pipe.
Amador	[1]13,562	34,346	Fire-clay products, sewer and chimney pipe, architectural terra cotta, porcelain, stoneware, pottery, sanitary ware, and drain tile.
Contra Costa	100	300	Pottery, floor and faience tile.
Humboldt	210	420	Drain tile and pottery.
Los Angeles	12,634	11,820	Terra cotta, sewer pipe, chimney pipe, red earthenware, stoneware, roofing and drain tile.
Orange	3,649	4,650	Drain tile, et al.
Placer	29,348	29,348	Terra cotta, roofing, floor, faience, et al. tile, sewer and chimney pipe, architectural terra cotta, sanitary ware.
Riverside	[2]48,195	80,454	Sewer pipe, pottery, terra cotta, et al.
Santa Clara and Sonoma*	2,050	1,600	Porcelain, red earthenware, sewer pipe, and terra cotta.
Totals	112,423	$166,788	

[1]Includes washed kaolin; also some 'fire sand' used in making fire brick.
[2]Includes some ball clay used for chinaware.
*Combined to conceal output of a single operator in each.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. The present form of clay blank sent out by the State Mining Bureau, and the co-operation of the operatives in filling it out, has enabled us to make a more intelligent compilation of the data than in earlier reports, both as to sources of the crude material and as to kinds and values of the manufactured articles. So far as we have been able to segregate them, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

The values of the various pottery clay products made in California during 1918, totaled $1,687,902, compared with $2,106,460 in 1917, their distribution being shown in the following tabulation:

Values of Pottery Clay Products, 1918.

Product	Number of producers	Value
Architectural terra cotta	4	$261,984
Chimney pipe, terra cotta, and flue linings	6	25,097
Drain tile	8	54,366
Roofing tile	3	109,156
Sewer pipe	6	599,685
Stoneware and sanitary ware	7	568,267
Red earthenware	4	25,678
Miscellaneous—including art pottery, conduit pipe, floor and faience tile, and mortar colors	7	43,669
Total value		$1,687,902

A recent and unique addition to the pottery industry of California is the making of bisque doll heads by the California China Company at Berkeley. The plant was built in 1916, but made no commercial output until 1919. They are at present making deliveries on a large contract with an eastern firm of doll manufacturers. This is stated to be the only firm in the United States at present producing and selling bisque doll heads on a commercial scale. Before the war, such articles were imported from Germany. This plant is using mainly California clays, silica, and feldspar.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1904	84,149	$81,952
1888	75,000	37,500	1905	133,805	130,146
1889	75,000	37,500	1906	167,267	162,283
1890	100,000	50,000	1907	160,385	254,454
1891	100,000	50,000	1908	208,042	325,147
1892	100,000	50,000	1909	299,424	465,647
1893	24,856	67,284	1910	249,028	324,099
1894	28,475	35,073	1911	224,576	252,759
1895	37,660	39,685	1912	199,605	215,683
1896	41,907	62,900	1913	231,179	261,273
1897	24,592	30,290	1914	179,948	167,552
1898	28,947	33,747	1915	157,866	133,724
1899	40,600	42,700	1916	134,636	146,538
1900	59,636	60,956	1917	166,298	154,602
1901	55,679	39,144	1918	112,423	166,788
1902	67,933	74,163			
1903	90,972	99,907	Totals	3,734,888	$4,090,996

DOLOMITE.

Bibliography: Report XV. Bulletin 67.

Previous to the 1915 report dolomite was included under limestone. Limestones are frequently more or less magnesian-bearing, and a chemical analysis is often necessary to definitely decide as to whether they are calcite or dolomite; the latter standing intermediate between magnesite ($MgCO_3$) and calcite ($CaCO_3$). Since dolomite, as such, has been found to have certain distinctive applications, we have deemed it worthy of a separate classification.

The major portion of the tonnage being shipped is utilized as a refractory lining in the bottoms of open-hearth steel furnaces, as a partial substitute for magnesite. A portion is used for its carbonic acid gas (CO_2), and part for its magnesia. We are also informed that some calcined dolomite has been used by the paper mills. As the San Benito and Monterey dolomite has been found to contain the proper proportions of lime and magnesia, it can replace an artificial mixture of calcined limestone and magnesite in the manufacture of paper from wood pulp. Dolomite is also sometimes used as a flux in metal smelting.

The production of dolomite for the year 1918 amounted to 24,560 tons, valued at $79,441, and came from a total of 7 quarries in 4 counties, distributed as follows:

County	Tons	Value
Inyo	14,390	$32,056
Monterey	4,900	25,950
San Benito	5,000	20,625
San Bernardino	270	810
Totals	24,560	$79,441

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
Totals	69,976	$206,927

FELDSPAR.

Bibliography: Report XV. Bulletin 67. U. S. Bur. of M., Bull. 92.

Feldspar was produced in four counties during 1918, to the amount of 4,132 tons, valued at $22,061. The output of Riverside County was used mainly in cement manufacture, its potash content being recovered as a by-product.

Feldspar production only dates back to 1910 in California. The mineral is a constituent of many rocks, but can only be commercially produced from pegmatites where the crystals are large and quite free from impurities. The open-cut method of mining this material is commonly used. Manufacturers of enamel wares and pottery have previously bought most of the better grades of feldspar produced. Small quantities are used in the manufacture of glass and scouring soaps, and the more impure material is utilized as chicken grit, in making various brands of roofing, and in other ways. Various experiments have been made with the potash feldspars in the attempt to extract their potash content for use in fertilizers. Some recent developments along these lines are enumerated under Potash. The most successful of these has been accomplished through the medium of cement manufacture, and recovery of the potash as a by-product.

[1]"The requirements of the pottery trade demand that in general the percentage of free quartz associated with the feldspar used for this purpose shall not exceed 20 per cent in the ground product, and certain potters demand a spar which is nearly pure, containing probably less than 5 per cent of free quartz. In order to be profitably worked in most feldspar mines between one-fourth and one-half of the total material that must be excavated should contain less than 20 per cent of free quartz. Freshness of the feldspar, though desirable, is not essential.

"A factor of the utmost importance in the mining of pottery spar is the quantity of iron-bearing minerals (black mica, hornblende, garnet, black tourmaline, etc.) present and the manner in which these minerals are associated with the feldspar. The requirements of the pottery trade demand that the spar be nearly free from these minerals. In order that a deposit may be worked profitably these minerals, if present in any appreciable quantity, must be so segregated in certain portions of the deposit that they can be separated from the spar without much more hand sorting and cobbing than is necessary anyway in the separation of the highly feldspathic material from that which is highly quartzose or rich in muscovite. The presence here and there of minute flakes of white mica (muscovite) is characteristic even of the highest grades of commercial feldspar, and this mineral is not injurious except in so far as it is exceedingly difficult to pulverize the thin, flexible mica plates to a fineness equal to that required in the feldspar, and it is therefore necessary in mining to separate carefully as much of the muscovite as possible from the spar.

"Recently potash feldspars have been sought as a source of potash salts and also by reason of their potash content for incorporation in so-called complete fertilizers. For such purposes the prices paid are generally less than for pottery feldspar of first and second grade, and if such use of feldspar is found practicable the quantities required will be far in excess of those heretofore annually required by the pottery industries. To supply such a demand pegmatite deposits must be of large size and very favorably located with respect to transportation facilities and market.

"The requirements for extraction of potash and for use in fertilizer are a high potash content and convenience of location. The presence of quartz and of iron-bearing and other minerals in small quantities is of no significance. Both white and black mica are potash-bearing minerals and therefore not wholly undesirable.

"Almost any coarse, undecomposed granite pegmatite is adapted to the manufacture of roofing materials and poultry grit, but these products command such low prices that they can be marketed only under very favorable conditions."

[1]Katz, F. J., Feldspar in 1916: U. S. Geol. Surv., Min. Res. of U. S., 1916, Part II, p. 175, 1917.

The 1918 output in California was distributed by counties, as follows:

County	Tons	Value
Monterey	700	$3,800
Riverside	2,288	11,733
San Diego	700	3,600
Tulare	444	2,928
Totals	4,132	$22,061

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1916	2,630	$14,350
1911	740	4,560	1917	11,792	46,411
1912	1,382	6,180	1918	4,132	22,061
1913	2,129	7,850			
1914	3,530	16,565	Totals	28,895	$132,692
1915	1,800	9,000			

FLUORSPAR.

Bibliography: Bulletin 67.

Fluorspar is used as a flux in steel and iron smelting, and in the production of aluminum. It is also utilized in the manufacture of hydrofluoric acid, glass, porcelain, enamels and sanitary ware.

[1]"The market for the bulk of the fluorspar sold in the United States depends on the steel industry and the demand fluctuates with the rise and fall in the production of steel. Gravel spar is consumed as a flux in basic open-hearth steel furnaces and to a smaller extent in other metallurgical operations. In both 1914 and 1915 the sales of gravel spar constituted between 83 and 84 per cent of the total marketed output of domestic fluorspar, and in 1916 it was nearly 86 per cent. Fluorspar is used also as a flux in iron blast furnaces, iron foundries, and in gold, silver, copper, and lead smelters; in the manufacture of fluorides of iron and manganese for steel fluxing and of sodium fluoride for wood preservation[2]; in the manufacture of glass, enameled, and sanitary ware, and of hydrofluoric acid; in the electrolytic refining of antimony and lead; and in the production of aluminum. Other miscellaneous uses of fluorspar that have been reported are as a bonding for constituents of emery wheels, for carbon electrodes, in the extraction of potash from feldspar, and in the recovery of potash in Portland cement manufacture. The last use depends on the suitability of calcium fluoride as a reagent for increasing the volatilization of potassium salts from the clinker and the regeneration of the reagent from the dust collected.[3]"

In California, deposits have been reported in Los Angeles, Mono, Riverside, and San Bernardino counties, but up to 1917 no commercial production had resulted. As the 1918 output came from a single operator in Riverside County, the amount and value are concealed under the Unapportioned item. It is reported that there will be some production from Los Angeles County in 1919.

[1]Burchard, E. F., Fluorspar and cryolite in 1916: U. S. Geol. Surv., Min. Res. of U. S., 1916, Part II, p. 315, 1917.

[2]Teesdale, C. H., Use of fluorides in wood preservation: Wood Preserving, vol. 3, No. 4; vol. 4, No. 1. (Reprint, 9 pp.)

[3]Treanor, John, Potash from cement at the Riverside Portland Cement Co.: Met. and Chem. Eng., June 15, 1917, pp. 701-703.

FULLER'S EARTH.

Bibliography: Bulletin 38. U. S. Bur. of M., Bull. 71.

Fuller's earth production in California during the year 1918 amounted to 37 tons, valued at $333, as compared with 220 tons valued at $2,180 in 1917.

This material is soft and friable, and, in general, resembles a clay, but is non-plastic. It has no definite mineralogical composition, and its commercial value is determined by its physical properties, *i. e.*, texture, and filtering and absorbent properties.

In California, fuller's earth is used in clarifying both refined mineral and vegetable oils, although its original use was in fulling wool, as the name indicates. Production has mainly come from Calaveras and Solano counties. Deposits have also been found in Riverside, Fresno and Kern counties.

It was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1910	340	$3,820
1900	500	3,750	1911	466	5,294
1901	1,000	19,500	1912	876	6,500
1902	987	19,246	1913	460	3,700
1903	250	4,750	1914	760	5,928
1904	500	9,500	1915	692	4,002
1905	1,344	38,000	1916	110	550
1906	440	10,500	1917	220	2,180
1907	100	1,000	1918	37	333
1908	50	1,000			
1909	459	7,385	Totals	10,211	$159,338

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV. Bulletins 37, 67.

Accounting for the production of gems in California is somewhat unsatisfactory, owing to the widely scattered places at which stones are gathered and marketed in a very small way. The following table shows the production, by counties, of rough uncut materials during 1918:

County	Value	Kind
Butte	*$650	Diamonds.
Los Angeles		Beach stones (jasper and chalcedony).
Riverside		Quartz crystals.
San Bernardino		Bloodstone and blue chalcedony.
Tulare		Chrysoprase.

*Combined to conceal output of single operator in each.

For the first time in many years, there was no production reported of tourmalines from San Diego County in 1918.

California tourmalines are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green; also more recently a blue tourmaline has been found.

Two of our California gem stones, kunzite and benitoite, are not found elsewhere in the world; and these, each in but a single locality here: the former in the Pala Chief Mine in San Diego County, and the latter in the Dallas Mine in San Benito County.

Californite, or 'California jade,' is a gem variety of vesuvianite, and is green or white in color.

Some rhodonite has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

There was some chrysoprase produced in Tulare County in 1918.

The value of the total gem production in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1911	$51,824
1901	40,000	1912	23,050
1902	162,100	1913	13,740
1903	110,500	1914	3,970
1904	136,000	1915	3,565
1905	148,500	1916	4,752
1906	497,090	1917	3,049
1907	232,642	1918	650
1908	208,950		
1909	193,700	Total	$2,092,057
1910	237,475		

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV. Bulletin 67. U. S. G. S., Min. Res. 1914, Pt. II.

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for

these deposits, which are not high grade, to compete with foreign supplies which go on the market almost directly as they come from the deposit. Low-grade ores are concentrated with considerable difficulty and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to a recent report by the U. S. Geological Survey, "at present prices, miners in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price. Improved methods of graphite milling, adopted during the last year, promise to increase largely the production of flake of better grade."

On account of its infusibility and resistance to the action of molten metals, graphite is very valuable. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. The price increases with the grade of the material until the best quality crystalline variety, ordinarily ranges as high as $200 per ton. Because of the increased demand during the war period for brass and crucible steel, the requirement for graphite crucibles grew rapidly, thus boosting the price of flake graphite to above $400 per ton for Ceylon lumps. The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Since the close of hostilities in Europe, prices have declined to nearly the pre-war level; and imports are being resumed from Ceylon, Canada and Madagascar.

Among the newer uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1918 production was reported from Los Angeles County. It was concentrated from a disseminated ore, and was used for paint, foundry facing, and lubricants. As there was but a single operator,

the figures are concealed under the 'Unapportioned' item. The production, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903	----------	----------
1913	2,500	25
1914	----------	----------
1915	----------	----------
1916	29,190	2,335
1917	*	*
1918	*	*
Totals	243,690	$8,520

*Concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: Reports XIV, XV. Bulletins 38, 67.

Gypsum is widely distributed throughout the state, and is produced to a considerable extent, to supply the fertilizer manufacturers and also those of plaster and cement.

The action of gypsum as a fertilizer is indirect[1]; it is not a food for plants, but it is supposed to act on the double silicate of magnesia and potash in the soil, freeing the magnesia and potash, so that they become available as plant food. Its use is believed to be beneficial only if these elements are present in the soil, and its application to some soils would therefore be of no advantage.

Some authorities hold that land plaster tends to make nonporous clay soils more pervious to water and to make sandy soils less pervious. Ground gypsum has an affinity for water and will draw moisture from the atmosphere, so it keeps moisture in the soil and is of value to the farmer who is starting grain and grass crops, as it holds moisture where the roots of the small plants most need it. The use of ground gypsum or land plaster in a dry, hot season may draw enough moisture from the atmosphere to save a crop from damage by drought. Land plaster is employed to neutralize the black alkali that forms in many of the soils of arid regions, as in parts of California, Nevada and Utah.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

In the calcined form as plaster of Paris, gypsum plays a very important part in surgical work. It is also widely used in building operations, as a hard-wall plaster, as plaster board, etc.

[1]U. S. G. S. Press Bulletin No. 374, July, 1918, p. 4.

During 1918, producers in Riverside and San Bernardino counties took out a total of 19,695 tons, valued at $37,176, being a decrease from the 30,825 tons, valued at $56,840 in 1917. Approximately 20% of the 1918 output was utilized as 'land plaster.'

Total annual production of gypsum in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1904	8,350	$56,592
1888	2,500	25,000	1905	12,850	54,500
1889	3,000	30,000	1906	21,000	69,000
1890	3,000	30,000	1907	8,900	57,700
1891	2,000	20,000	1908	34,600	155,400
1892	2,000	20,000	1909	30,700	138,176
1893	1,620	14,280	1910	45,294	129,152
1894	2,446	24,584	1911	31,457	101,475
1895	5,158	51,014	1912	37,529	117,388
1896	1,310	12,580	1913	47,100	135,050
1897	2,200	19,250	1914	29,734	78,375
1898	3,100	23,600	1915	20,200	48,953
1899	3,663	14,950	1916	33,384	59,533
1900	2,522	10,088	1917	30,825	56,840
1901	3,875	38,750	1918	19,695	37,176
1902	10,200	53,500			
1903	6,914	46,441	Totals	469,826	$1,756,347

INFUSORIAL and DIATOMACEOUS EARTHS.

Bibliography: State Mineralogist Reports II, XII, XIII, XIV, XV. Bulletins 38, 67.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent; and it is also employed in the manufacture of scouring soap and polishing powders, and in making some classes of refractory brick. It is a first-class non-conductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes, and safes and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be

utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultra-marine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier-maché, and for solidifying bromine.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality. Infusorial earth is also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

During 1918, five quarries operating in Monterey and Santa Barbara counties, produced a total of 35,963 tons, valued at \$189,459, which is a material increase over the 24,301 tons, valued at \$127,510 in 1917.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	\$1,335	1905	3,000	\$15,000
1890			1906	2,430	14,400
1891			1907	2,531	28,948
1892			1908	2,950	32,012
1893	50	2,000	1909	500	3,500
1894	51	2,040	1910	1,843	17,617
1895			1911	2,194	19,670
1896			1912	4,129	17,074
1897	5	200	1913	8,645	35,968
1898			1914	12,840	80,350
1899			1915	12,400	62,000
1900			1916	15,322	80,649
1901			1917	24,301	127,510
1902	422	2,532	1918	35,963	189,459
1903	2,703	16,015			
1904	6,950	112,282	Totals	139,268	\$860,561

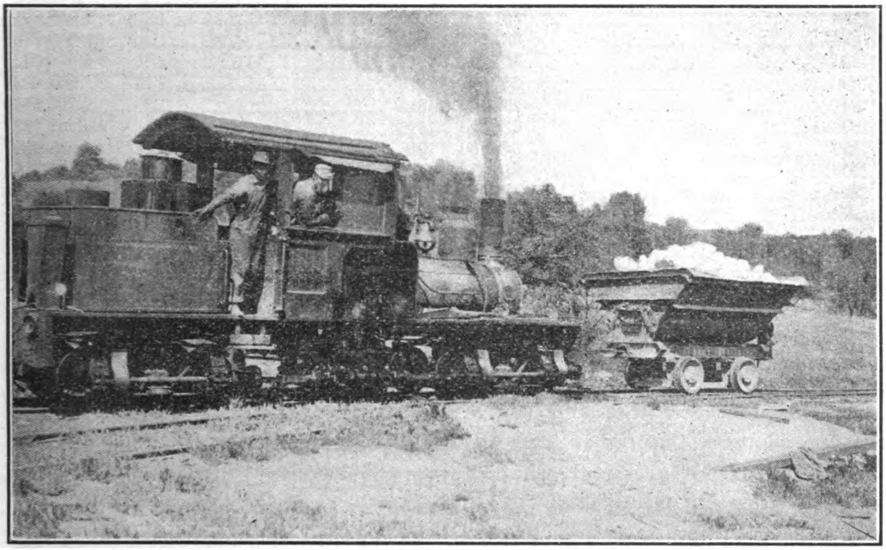
LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV. Bulletin 38. Oregon Agr. College Extension Bulletin 305.

Limestone was produced in ten counties during 1918, to the amount of 208,566 tons, valued at \$456,258. This amount does not include the limestone used in the manufacture of cement nor of lime for building purposes, but accounts for that utilized as a smelter flux, for glass and sugar making, and in other chemical and manufacturing processes (including fertilizers, roofing preparations, whiting for paint, terrazzo and for CO_2).

In agriculture, the chief reason for the use of lime is now recognized to be that of correcting soil acidity. Lime is stated to be especially

necessary for the proper development of the bacteria in the nodules on the roots of the legumes such as the clovers and alfalfa. It will also combine with some of the plant food materials already in the soil to make them more readily available, and will supply any lack of calcium as a plant food that may exist in the soil. To some extent, certain forms of lime will make heavy soils more friable, thus aiding aeration, cultivation and drainage. It may be applied, ground, in either the burned or un-burned form, or as hydrated lime.



Hauling limestone, near Shingle Springs, El Dorado County.

Distribution of the 1918 output is as follows:

County	Tons	Value
El Dorado	96,673	$218,120
San Bernardino	10,852	13,323
Santa Barbara	3,790	18,830
Santa Cruz	7,132	15,313
Shasta	45,671	72,410
Tulare	8,400	32,400
Tuolumne	3,064	5,600
Alameda, Kern, Inyo*	32,984	80,262
Totals	208,566	$456,258

*Combined to conceal output of a single operator in each.

In the early reports of this Bureau values for lime and limestone were not segregated. The following tabulation shows the total com-

bined value of such material since records for the state were first compiled, in 1887, to date:

Year	Value	Year	Value
1887	$368,750	1904	$658,956
1888	381,750	1905	878,647
1889	416,780	1906	925,887
1890	350,000	1907	1,162,417
1891	300,000	1908	676,507
1892	300,000	1909	997,745
1893	301,276	1910	1,058,891
1894	337,975	1911	843,778
1895	457,784	1912	1,034,688
1896	332,617	1913	803,002
1897	291,465	1914	896,376
1898	278,558	1915	442,592
1899	343,760	1916	608,208
1900	315,231	1917	667,776
1901	434,133	1918	917,573
1902	460,140		
1903	582,268	Total	$18,825,530

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV. Bulletins 38, 67.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915. Some amblygonite, a lithium phosphate, has also been obtained from pockets associated with the gem tourmalines. In 1918, the yield of lepidolite was 4,111 tons, valued at $73,998, and was utilized in glass manufacture.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1906	-------	-------
1900	440	11,000	1915	91	$1,365
1901	1,100	27,500	1916	71	1,065
1902	822	31,880	1917	880	8,800
1903	700	27,300	1918	4,111	73,998
1904	641	25,000			
1905	25	276	Totals	5,005	$212,784

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	Tons	Value
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

[1]"The different uses to which mica is put depend on its form—whether in sheets or in powder. Sheet mica is used in the electrical industry, for glazing, and to some extent for other purposes. Ground mica is used chiefly in the decorative trades and in insulation.

"Sheet mica finds its greatest use in the electrical industry, where an insulating, noninflammable material is necessary. It is used in sheets and as washers and disks in dynamo-electric machinery, electric-light sockets, spark plugs, insulators, guards in rheostats, fuse boxes, and telephones. Flexible cloth and tape, covered with mica, find varied uses in electrical apparatus. Sheet mica is used for glazing the fronts of stoves and for making lamp chimneys and lamp shades. It is also used in spectacles, automobile shields, phonograph diaphragms, in windows where glass would be broken, and in lantern transparencies.

"Ground mica is used for decoration in wall paper, to which it gives luster and brightness; in fancy paints, ornamental tiles, concrete, rubber goods, pipe and boiler coverings, insulating compounds, fireproof paints and coverings, patent roofing material, molded mica (ground mica mixed with shellac), and calico printing; as absorbent for nitroglycerin in the manufacture of 'mica powder,' in tempering steel; to a large extent as a lubricant for wooden bearings, or, mixed with oil, as a lubricant for metal bearings; and as a filler for various products. Tar and other roofing papers are coated with coarsely ground mica to prevent sticking when they are rolled for shipment. A possible value of ground mica as a chemical source of potash salts is indicated in a recent Geological Survey report.[2]

"It is understood that sheet mica has come to be of importance as a war mineral through its use abroad as windows in masks worn for defense against asphyxiating gases, and for other uses where a transparent, noninflammable, nonshattering material is necessary, as in automobile goggles and in windows for armored cars."

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII, XIII, XIV, XV. Bulletin 38.

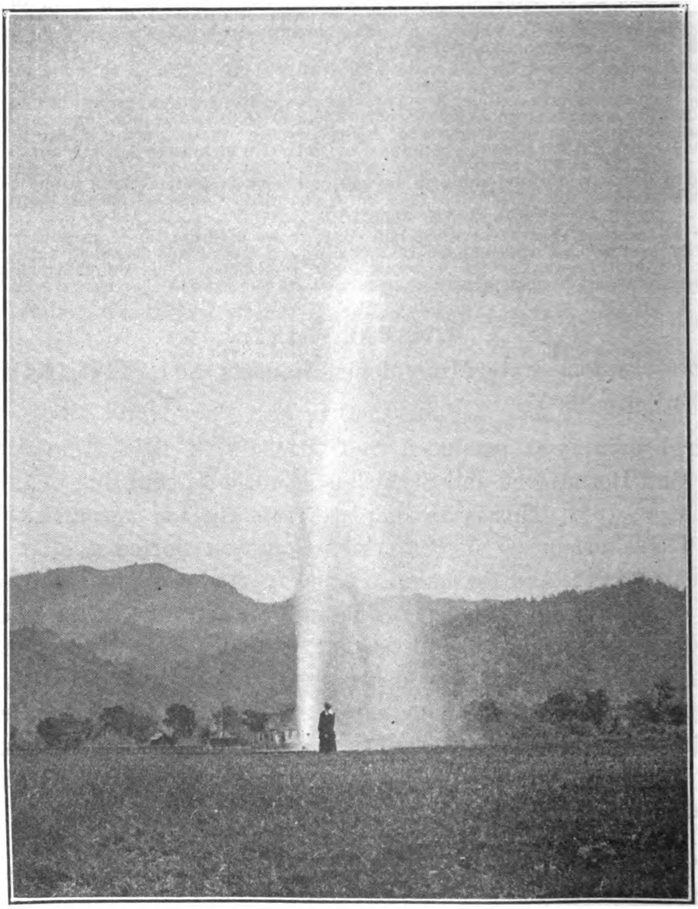
Mineral paint was produced in California in 1918 from Amador, Colusa, San Bernardino and Stanislaus counties, amounting to 728 tons, valued at $4,738. This is an increase from the tonnage and value of 1917. Three producers in Stanislaus County reported a total of 498 tons worth $3,088, and the balance came from single producers in each of the other counties named. The material from Colusa and San Bernardino was hematite and jasper, while that from Amador and Stanislaus was red and yellow ochre, respectively. The Calaveras and Stanislaus yellow ochre is the equal of any of the imported ochres.

Besides the above-named counties, deposits of mineral paint are located in the following: Kern, Kings, Lake, Los Angeles, Nevada, Riverside, and Sonoma.

[1]Schaller, W. T., Mica in 1916: U. S. Geol. Surv., Min. Res. of U. S., 1916, p. 304, 1917.
[2]Butler, B. S., Potash in certain copper and gold ores, with a note on muscovite by George Steiger: U. S. Geol. Survey Bull. 620, pp. 227-235, 1916.

The first recorded production of this material in the state was in the year 1890. The output showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1906	250	$1,720
1891	22	880	1907	250	1,720
1892	25	750	1908	335	2,250
1893	590	26,795	1909	305	2,325
1894	610	14,140	1910	200	2,040
1895	750	8,425	1911	186	1,184
1896	395	5,540	1912	300	1,800
1897	578	8,165	1913	303	1,780
1898	653	9,698	1914	132	847
1899	1,704	20,294	1915	311	1,756
1900	529	3,993	1916	643	3,960
1901	325	875	1917	520	2,700
1902	589	1,533	1918	728	4,738
1903	2,370	3,720			
1904	270	1,985	Totals	14,667	$140,118
1905	754	4,025			



The half-hour geyser at Myrtledale Farm, near Calistoga, Napa County.

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII, XIII, XIV, XV. U. S. G. S., Water Supply Paper 338.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having

The two-hour geyser at Light's Winery, Calistoga, Napa County.

a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing. From a therapeutic standpoint, California is particularly rich

in mineral springs. The counterparts of practically any of the world-famed spas of Europe or the eastern United States can be found here.

An interesting, recent development is the obtaining of 'geyser' wells at Calistoga, in Napa County, by drilling into the thermal-water strata underlying that part of the Napa Valley. There are at least four wells so erupting at the present time. They spout in true geyser fashion, and their periods vary from 10 minutes to 2 hours, each following its own schedule rather closely.

Commercial production by counties, for 1918, was:

County	Gallons	Value
Butte	3,900	$1,680
Calaveras	10,938	6,069
Contra Costa	30,376	3,038
Lake	87,067	15,006
Los Angeles	110,481	15,540
Napa	92,512	59,620
San Bernardino	601,500	60,150
Santa Barbara	73,117	97,162
Santa Clara	13,025	1,678
Siskiyou	501,750	50,175
Solano	11,440	2,722
Sonoma	83,220	36,050
Colusa, Humboldt, Marin, Riverside, San Benito, San Diego, San Luis Obispo, Shasta, Trinity*	189,465	26,760
Totals	1,808,791	$375,650

*Combined to conceal output of a single operator in each.

Amount and value of mineral water produced in California since 1887 are given herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1904	2,430,320	$496,946
1888	1,112,202	252,990	1905	2,194,150	538,700
1889	808,625	252,241	1906	1,585,690	478,186
1890	258,722	89,786	1907	2,924,269	544,016
1891	334,553	139,959	1908	2,789,715	560,507
1892	331,875	162,019	1909	2,449,834	465,488
1893	383,179	90,667	1910	2,335,259	522,009
1894	402,275	184,481	1911	2,637,669	590,654
1895	701,397	291,500	1912	2,497,794	529,384
1896	808,843	337,434	1913	2,350,792	599,748
1897	1,508,192	345,863	1914	2,443,572	476,169
1898	1,429,809	213,817	1915	2,274,267	467,738
1899	1,338,537	406,691	1916	2,273,817	410,112
1900	2,456,115	268,607	1917	1,942,020	340,566
1901	1,555,328	559,057	1918	1,808,791	375,650
1902	1,701,142	612,477			
1903	2,056,340	558,201	Totals	52,743,255	$12,306,031

PHOSPHATES.

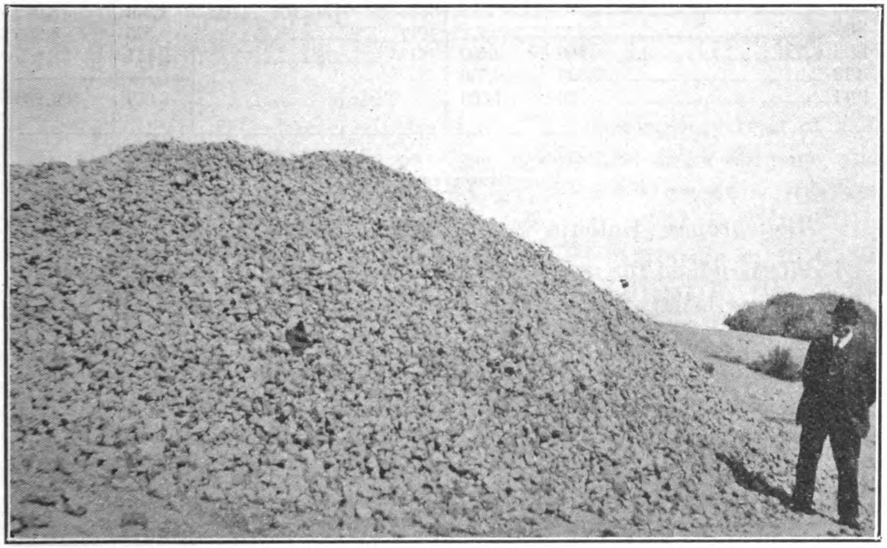
Bibliography: Bulletin 67.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithia phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV. Bulletin 38 (see 'Tufa').

The production of pumice and volcanic ash for the year 1918 amounted to 2,114 tons, valued at $28,669, and came from Humboldt, Imperial



Brand & Stevens' Pumice, Imperial County. Thirty-ton dump of pumice, selected for grinding, awaiting shipment. Shows average size of material obtained. Photo by Emile Huguenin.

and Siskiyou counties. This is a considerable increase over the 525 tons, valued at $51,295, in 1917; and is due to shipments from a deposit near Mt. Shasta in Siskiyou County, and also to an increased output from Imperial County. The material from Imperial and Siskiyou counties is the vesicular, block pumice, these being practically the only localities in the United States producing this class of rock at the present time; and is stated to have found a ready market. The Lipari Islands, Italy, have in the past been the principal source of supply of block

pumice. This form is used largely for abrasive purposes; and is also being utilized in fire-brick, and as an insulating filler in the walls of refrigerators and cold-storage plants. There are other known deposits of pumice in California, in Inyo, Madera, and Mono counties. The material from Humboldt, Inyo and Madera counties is the fine-grained, volcanic ash, or tuff variety. It is employed in making scouring soaps and polishing powders.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1915	380	$6,400
1910	----	----	1916	1,246	18,092
1911	----	----	1917	525	5,295
1912	100	2,500	1918	2,114	28,669
1913	3,590	4,500			
1914	50	1,000	Totals	8,055	$66,956

PYRITE.

Bibliography: Bulletin 38. Min. & Sci. Press, Vol. 114, pp. 825, 840.

Pyrite is mined for use in the manufacture of sulphuric acid, which in turn was being used in large quantities during the past four years in the preparation of explosives. Experiments are being made as to the effect of sulphur, sulphuric acid, and SO_2 in the correction and fertilization of alkali soils. Two properties in Alameda County and one each in Shasta and El Dorado reported a total production in 1918 of 128,329 tons, valued at $425,012, which is an increase over 1917.

This does not include the vast quantities of pyrite which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates for their precious-metal values. California has, available, supplies of sulphide ores suitable for the manufacture of sulphuric acid far in excess of the local requirements; but the excess acid if made here is not of sufficient value per ton to pay the freight rates to Eastern markets. One of our large copper smelters here could, alone, flood the market with sulphuric acid from its copper ores roasted.

The total recorded pyrite production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1910	42,621	$179,862
1899	5,400	28,620	1911	54,225	182,954
1900	3,642	21,133	1912	69,872	203,470
1901	4,578	18,429	1913	79,000	218,537
1902	17,525	60,306	1914	79,267	230,058
1903	24,311	94,000	1915	92,462	293,148
1904	15,043	62,992	1916	120,525	372,969
1905	15,503	63,958	1917	111,325	328,704
1906	46,689	145,895	1918	128,329	425,012
1907	82,270	251,774			
1908	107,081	610,335	Totals	1,563,535	$5,207,008
1909	457,867	1,389,802			

SILICA—SAND and QUARTZ.

Bibliography: State Mineralogist Reports IX, XIV. Bulletins 38, 67.

We combine these materials, because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. Some also was utilized as a foundry flux. In 1918, a portion of the silica sold (both sand and quartz) was used in glazes for porcelain, pottery and tile; and some of the sand for the preparation of silicate of soda.

The production of silica in 1918 amounted to 23,257 tons, valued at $88,930, from 13 properties in Amador, El Dorado, Monterey, Placer, Riverside, and Tulare counties:

County	Tons	Value
Amador	13,747	$61,724
Riverside	1,400	4,800
Tulare	204	1,143
Monterey, El Dorado, Placer*	7,906	21,263
Totals	23,257	$88,930

*Combined to conceal output of a single operator in each.

Of the above total 7,685 tons were of vein and boulder quartz, and 15,522 tons, sand.

Practically all the glass sand produced in California occurs as such and needs no grinding. There are various deposits of quartz which

could be utilized for glass making, but to date there has been only a small commercial production of this class of material.

Glass sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Monterey, Orange, Placer, Riverside, San Joaquin, and Tulare. The chief producing centers have been Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly glass sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1910	19,224	$18,265
1900	2,200	2,200	1911	8,620	8,672
1901	5,000	16,250	1912	13,075	15,404
1902	4,500	12,225	1913	18,618	21,899
1903	7,725	7,525	1914	28,538	22,688
1904	10,004	12,276	1915	28,904	34,322
1905	9,257	8,121	1916	20,880	48,908
1906	9,750	13,375	1917	19,376	41,166
1907	11,065	8,178	1918	23,257	88,930
1908	9,255	22,045			
1909	12,259	25,517	Totals	264,507	$431,466

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV. Bulletins 38, 67.

Talc—also called soapstone or steatite—occurs widely distributed throughout California. It is found as a hydration product in the alteration of magnesian silicates, and is often associated with serpentine and actinolite. But few deposits have been proven of especial value to date, although there is an undoubted future for this branch of the mineral industry in the state. Deposits of high-grade white talc, the equal of the imported Italian article, are now being developed in Inyo and San Bernardino counties. It is used in making paper, rubber, toilet articles, soap, rice polishing, lubricants, tiling, etc., and for such is ordinarily ground to about 200 mesh before marketing. In this condition it brings $15 per ton and upwards, depending on quality. Commercially, the higher grades are called talc, and the lower, soapstone. Soapstone blocks are used in fireless cookers, electrical switchboards, laboratory table tops and laundry tubs; and the crushed material is used in roofing papers.

There was a total output in 1918 of 11,760 tons, valued at $85,534, from four producers in Inyo County, two in San Bernardino, and one

each in Amador, El Dorado, and Tulare. This is an increase over the 1917 output.

County	Tons	Value
Inyo	9,635	$72,549
San Bernardino	430	4,210
Amador, El Dorado, and Tulare*	1,695	8,775
Totals	11,760	$85,534

*Combined to conceal output of a single operator in each.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1907	----------	----------
1894	----------	----------	1908	3	$48
1895	25	375	1909	33	280
1896	----------	----------	1910	740	7,260
1897	----------	----------	1911	----------	----------
1898	----------	----------	1912	1,750	7,350
1899	----------	----------	1913	1,350	6,150
1900	----------	----------	1914	1,000	4,500
1901	10	119	1915	1,663	14,750
1902	14	288	1916	1,703	9,831
1903	219	10,124	1917	5,267	45,279
1904	228	2,315	1918	11,760	85,534
1905	300	3,000			
1906	----------	----------	Totals	26,465	$214,953

STRONTIUM.

Bibliography: Bulletin 67. U. S. G. S., Bull. 540; 660-I.

Production of strontium minerals in California in 1918 amounted to 2,900 tons, worth $33,000, from San Bernardino County, being both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$). The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the first considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite.

In addition to the Imperial County occurrence, noted in our 1916 bulletin, celestite is also found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped. The above output was converted to the nitrate.

It is estimated by the U. S. Geological Survey, that prior to 1914 about 2,000 tons of strontium nitrate was used in the manufacture of flares, or Costen and Bengal lights and fireworks. The demand has since increased considerably. Previously, the nitrate was imported from Germany, England and Sicily.

There is undoubtedly a good future for the strontium minerals in California, if the beet-sugar factories will take up their use, as has been done in Germany. Strontia is much more efficient and satisfactory in that process than lime, as it is stated to give an additional recovery of 6%-8% over lime. In Germany and Russia, about 100,000 tons of strontium hydroxide were used annually in the sugar industry.

Of the two minerals, strontianite is the more desirable, but scarcer. Celestite is more abundant, and can be sold in large quantities at about $14-$18 per ton at the Atlantic seaboard. The carbonate during 1918 brought from $40-$50 per ton, crude, depending on quality. Celestite is found with limestones and sandstones and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67.

There has not been, for many years, any commercial output of native sulphur in California, although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Mariposa, San Bernardino, Sonoma, Tehama, and Ventura counties. Operations were begun late in 1917, on a property in Inyo County, and some material stated to assay 40% sulphur was mined. Difficulties were encountered in refining it, so that only a small production was made, but none shipped.

At the Elgin mine, near Wilbur Springs, in Colusa County, a small tonnage of sulphur was prepared toward the close of 1918, but not shipped that year. The orebody is stated to assay 52.6% S. over a width of 22 feet. Two retorts, steam-heated, have been installed, with a capacity of 4500 pounds of ore, each, per charge. There is a large body of material, in a zone at least 75 feet wide, impregnated with native sulphur crystals, which can be cheaply mined, if certain mechanical difficulties of melting and cleaning can be economically overcome.

Sulphur was produced at the famous Sulphur Bank mine, in Lake County, during the years 1865-1868 (inc.) totaling 941 tons, valued at $53,500; following which the property became more valuable for its quicksilver. The Elgin mine, noted above, is a similar occurrence.

About 37,000 tons of sulphur per year are imported to the United States from Japan, most of it coming in through the port of San Francisco. The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that the three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons.

Formerly considerable sulphur was imported from Italy, the Palermo district being the principal producer. The industry is under the control of the government, and exports are under license. According to a recent Consular Report:[1]

"Prices range from $55 to $57 for crude, to $73 to $85 for refined. As American sulphur is cheaper than Sicilian, it is believed that should freights become normal it will be possible to import American sulphur into Italy."

[1]Consular Report, Annual Series, No. 8c, Nov. 29, 1918, p. 8.

CHAPTER SIX.

SALINES.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties, although the State Mining Bureau kept no annual records of output previous to 1887. Except for a single year's absence, soda has had a continuous production since 1894. Potash, and magnesium chloride and sulphate have only recently been added to the commercial list, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, San Luis Obispo, and Siskiyou counties, and the waters of the Pacific Ocean.

The following tabulation shows amount and value of the saline minerals produced in California during the years 1917 and 1918, with increase or decrease in value for 1918, as compared with the previous year:

Substance	1917		1918		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borax	109,944	$2,561,958	88,772	$1,867,908	$694,050—
Magnesium salts	1,064	34,973	1,008	29,955	5,018—
Potash	129,022	4,202,889	49,381	6,808,976	2,606,087+
Salt	227,825	584,373	212,076	806,328	221,955+
Soda	24,505	928,578	20,447	855,423	73,155—
Totals		$8,312,771		$10,368,590	
Net increase					$2,055,819

BORAX.

Bibliography: State Mineralogist Reports III, X, XII, XIII, XIV, XV. Bulletins 24, 67.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake, in Lake County, was discovered in September of the same year by Dr. John A. Veatch. This deposit was worked in 1864-1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. This was the first commercial output of this salt in the United States, and California is still today the only American producer of borax.

Production from the dry lake or 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that

the borax industry was revolutionized by the discovery of the colemanite beds at Calico in San Bernardino County. These have since been worked out, and the present output comes from similar beds in Inyo and Los Angeles counties. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities.

During 1918, there was reported a total output of 88,772 tons, valued at $1,867,908, compared with 109,944 tons, valued at $2,561,958, in 1917. The decrease was due largely to freight car shortage.

Value of the state's borax output since 1887 is shown in the following table:

Year	Value	Year	Value
1887	$116,689	1904	$698,810
1888	196,636	1905	1,019,158
1889	145,473	1906	1,182,410
1890	480,152	1907	1,200,913
1891	640,000	1908	1,117,000
1892	838,787	1909	1,163,960
1893	593,292	1910	1,177,960
1894	807,807	1911	1,456,672
1895	595,900	1912	1,122,713
1896	675,400	1913	1,491,530
1897	1,080,000	1914	1,483,500
1898	1,153,000	1915	1,663,521
1899	1,139,882	1916	2,409,375
1900	1,013,251	1917	2,561,958
1901	982,380	1918	1,867,908
1902	2,234,994		
1903	661,400	Total	$34,972,431

MAGNESIUM SALTS.

Magnesium chloride is an important item in certain chemical uses, and in the preparation of Sorel cement in laying magnesite floors. Previous to 1915, Germany was the principal source of this chloride, which source has since, of course, been cut off. For this reason experiments have been made to prepare it by acid solution from magnesite, which is so abundant in California. Some of the salt companies began its commercial preparation in 1916, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride.

In 1917 and 1918, in addition to the chloride, some magnesium sulphate, or "technical epsom salts," was also made at the salt plant of the Oliver Chemical Company in Alameda County. This was sold to cotton goods manufacturers. The chloride sold for $20-$40 per ton, and the sulphate at $80-$90 per ton.

After operating an experimental plant during 1918, resulting in a moderate output of magnesium chloride, the Whitney Chemical Company in San Mateo County have since (January, 1919) completed a

well-equipped plant capable of producing 250 to 300 tons per month. They report:

"There is sufficient demand to keep us working to capacity if we can land the goods at the large distributing centers, which are mainly east of the Mississippi, on a proper competitive basis. With the publication of proper commodity rates this can be accomplished, otherwise a large proportion of the trade will seek their supplies, as they did before the war, of foreign manufacturers."

The 1918 output totaled 1,008 tons, valued at $29,955, from Alameda, Los Angeles and San Mateo counties, compared with 1,064 tons and $34,973 in 1917. The chloride was utilized in Sorel cement for flooring and stucco.

Bitterns made at plants on San Francisco Bay carry 23 to 86 parts of magnesium per thousand, or 2.3% to 8.6% magnesium.[1]

Metallic magnesium is prepared electrolytically, utilizing generally an electrolyte of magnesium chloride and an alkaline chloride. Its commonest known use is in the powdered form for flash lights in photography. Its largest recent use has been in the making of war munitions.[2]

It did not enter as an integral part into the explosives or arms, but small quantities were put in shrapnel shells, that observers and gunners might know exactly where the shells were bursting. By day the burning magnesium gives a dense pure-white cloud of magnesium oxide, and at night a dazzling white light. Larger quantities were used in aerial bombs and rockets for lighting up the country at night. Magnesium has as yet found but a limited direct use as a metal. Magnalium, an alloy of aluminum containing about 2% of magnesium and small percentages of other metals, is stated to be used in automobiles and aeroplanes. The possibilities for further important developments in this direction are promising.

NITRATES.

Bibliography: Report XV. Bulletin 24. U. S. G. S., Press Bulletin No. 373, July, 1918.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of intense interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

[1]U. S. Dept. Agr. Bur. Soils, Bull. 94, p. 66, 1913.
[2]U. S. G. S., Min. Res. 1915, Pt. I, p. 740.

POTASH.

Bibliography: Report XV. Bulletin 24. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789.

Potash production began commercially in California in 1914, with a small yield from kelp. Considerable money has been spent incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there is now on a commercial basis at two plants on Searles Lake. The imports of potash salts and fertilizers from Germany previous to the European war had an annual value of several millions of dollars, and their cessation made a domestic production imperative.

The normal pre-war price of $35 to $40 per ton for high-grade agricultural salts has been succeeded by figures of several times those amounts; until in April, 1916, the chloride was nominally quoted at $425 per ton and the sulphate from $350 to $400 per ton. The approximate average selling price in 1917 at point of shipment for potash materials was $4.26 per unit, corresponding to $426 per ton of 100% K_2O. In 1918, the prices received by California operators ranged from $3.80 to $4.90 per unit, with the average about $3.90.

As to the outlook for 1919, the War Trade Board on January 25th[1] announced:

"That it has received authentic and official information from the French High Commission in the United States to the effect that France will be unable, at least until April, to ship potash from the potash mines of Alsace. These advices further indicate that for the next few months practically the entire potash output of the Alsatian mines will be urgently required for agricultural purposes in France. It is the view of the War Trade Board, based upon this information, that even under the most favorable circumstances, no potash from Alsace could be available in the United States for agricultural uses before June, 1919, and that, therefore, it will be necessary that the United States rely entirely upon its domestic potash production for the coming spring season."

During 1918, a total of 49,381 tons of potash-bearing materials of all grades was produced in California, valued at $6,808,976. This is more than 50% increase in value over that of the 1917 output. The decrease in the tonnage figures is due to the fact that the Riverside County output was reduced to a 40% K_2O sulphate instead of the cement-mill dust being marketed unrefined carrying only 11% K_2O.

The 1918 product was, in part, refined potassium chloride and sulphate, kelp ash and dried kelp, varying in potash content from 59% K_2O for the refined salts down to 14% in the dried kelp; in part, refined sulphate and treater dust from several of the cement mills; and in part, concentrated salts from the brine of Searles Lake. Small tonnages of refined sulphate were also made from bitterns at two of the salt plants on San Francisco Bay. The yield from Los Angeles, San Diego, and

[1]Commerce Reports, U. S. Dept. of Commerce, No. 21, 1919, p. 385.

Santa Barbara counties is from the operations of kelp plants, except that a small portion of the 1918 product in San Diego was made directly from feldspar.

The bulk of this output was utilized in fertilizer preparations; but the product of at least one of the kelp plants was further refined or converted to the form of the nitrate for explosives manufacture. A small portion was converted into potassium permanganate. Some potassium iodide, also, was made experimentally; also some ammonia.

Other uses for potash salts besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography, and medicine.

The large plant of the American Trona Corporation at Trona, on Searles Lake, San Bernardino County, began commercial operation in September, 1916, and is shipping crude chloride of potash to Eastern fertilizer works. These crude salts carry the equivalent of from 20% to 38% K_2O. A second plant at Seales Lake, built by the Solvay Process Company, began commercial operation in 1917. Their product is a 65% KCl.

In the cement mill of the Riverside Portland Cement Company, the fine dust from ball and tube mills is collected by a Cottrell electrical fume precipitator, the material showing an approximately 11% potash content. Sulphate is prepared from this. Other cement plants, in San Bernardino and Santa Cruz counties, commenced recovery of potash in 1918. The Santa Clara product was 'potash char,' obtained by burning slops refuse from a distillery. That from Sacramento County was leached from the ash dump of the Sacramento City Incinerator.

The following tabulation shows the distribution of the 1918 output of potash in California:

County	Product	Equivalent % K_2O	Tons	Value
Los Angeles	Chloride, kelp ash, permanganate	25–50	2,380	$462,600
San Bernardino	Chloride, sulphate	20–44	27,545	3,428,443
San Diego	Chloride, dried kelp	10–58.5	10,392	1,578,874
Santa Barbara	Dried kelp and ash	18–39	1,863	256,780
Alameda, Riverside, Sacramento, San Mateo, Santa Clara, Santa Cruz*	Chloride, sulphate, distillery slops char	16–45	7,201	1,082,279
Totals			49,381	$6,808,976

*Combined to conceal output of a single operator in each.

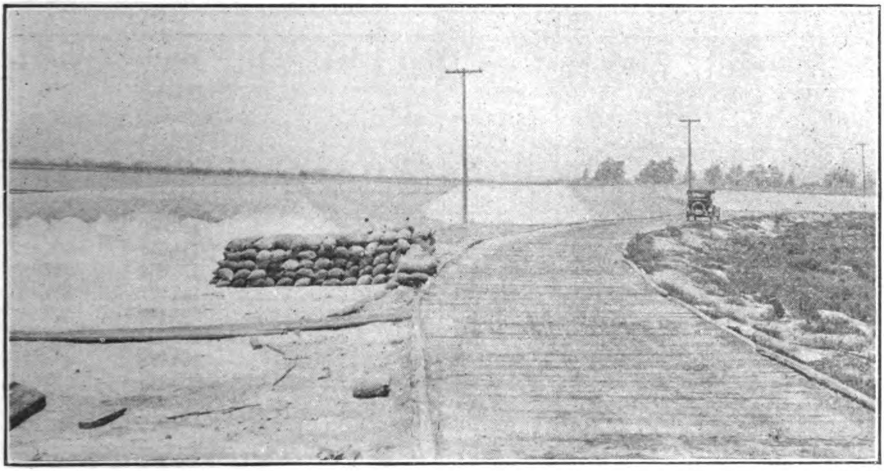
The annual amounts and values of these potash materials, since their beginning in California, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
Totals	197,397	$11,695,321

SALT.

Bibliography: State Mineralogist Reports II, XII, XIII, XIV, XV. Bulletin 24.

Most of the salt produced in California is obtained by evaporating the waters of the Pacific Ocean, plants being located on the shores of



Salt stacks at plant of Oliver Chemical Company, Alameda County.

San Francisco Bay, at Long Beach, and on San Diego Bay. Additional amounts are derived from lakes and lake beds in the desert regions of the state. The salt production of San Bernardino County is derived from deposits of rock salt which are worked by means of quarrying and steam shovels. A small amount of valuable medicinal salts is annually obtained in Mono and Tehama counties, by evaporation from mineral springs.

Formerly a considerable proportion of the table salt consumed in California was shipped in from Eastern points; but, at present, California salt refineries supply not only our own needs but export a fair tonnage to other markets.

The 1918 output amounted to 212,076 tons, valued at $806,328, distributed as follows, by counties:

County	Tons	Value
Alameda	130,132	$410,345
San Diego	10,631	61,717
San Mateo	26,434	144,604
Inyo, Kern, Los Angeles, Modoc, Mono, Monterey, San Bernardino, Solano*	44,879	189,662
Totals	212,076	$806,328

*Combined to conceal output of a single operator in each.

The above returns show a decrease in tonnage with an increase in value. There were 12 plants operating in Alameda, two each in San Diego and San Mateo, and one in each of the other counties tabulated, a total of 540 men being employed.

Amount and value of annual production of salt in California from 1887 to date is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1904	95,968	$187,300
1888	30,800	92,400	1905	77,118	141,925
1889	21,000	63,000	1906	101,650	213,228
1890	8,729	57,085	1907	88,063	310,967
1891	20,094	90,303	1908	121,764	281,469
1892	23,570	104,788	1909	155,680	414,708
1893	50,500	213,000	1910	174,920	395,417
1894	49,131	140,087	1911	173,332	324,255
1895	53,031	150,576	1912	185,721	383,370
1896	64,743	153,244	1913	204,407	462,681
1897	67,851	157,520	1914	223,806	583,553
1898	93,421	170,855	1915	169,028	368,737
1899	82,654	149,588	1916	186,148	455,695
1900	89,338	204,754	1917	227,825	584,373
1901	126,218	366,376	1918	212,076	806,328
1902	115,208	205,876			
1903	102,895	211,365	Totals	3,424,689	$8,556,823

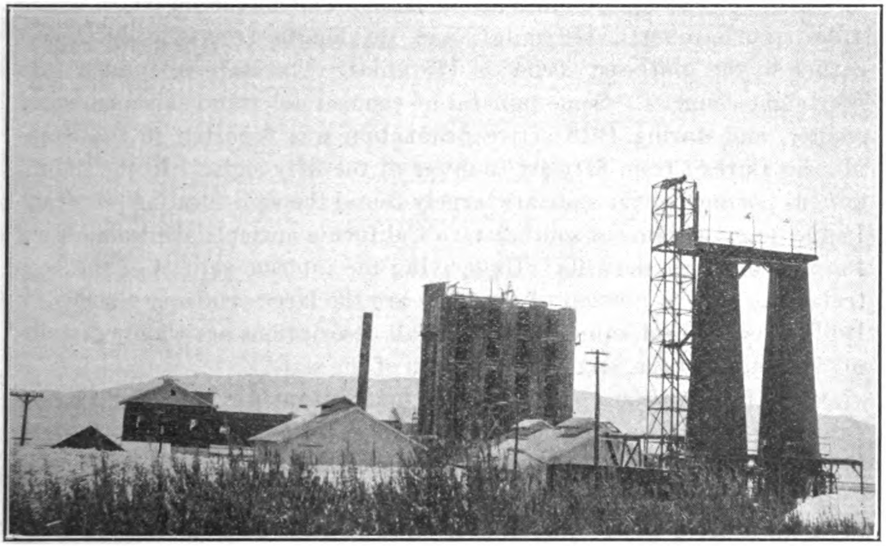
SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV. Bulletins 24, 67.

The production of the carbonates and sulphate of sodium, in California in 1918 included: both the bicarbonate and soda ash from plants at Owens Lake, and the natural sulphate from the Carrizo Plains, San Luis Obispo County. The total tonnage was 20,447, valued at $855,423, the bulk of which came from the three plants in Inyo County.

These 'sodas' were used in the manufacture of glass, soap, and paper, as well as washing and baking soda, also in sugar refining.

The war stimulated the chemical industry in the United States to produce materials that were formerly imported and to supply them to foreign countries, as well as to devise new uses for chemical products, also to replace more expensive by less expensive chemicals. Sodium compounds have replaced potassium compounds, either wholly or in part, in glass and soap making, in photography, in match making, in tanning,



California Alkali Company's soda plant at Cartago, Owens Lake, Inyo County. Photo by Emile Huguenin.

and in the manufacture of cyanide for extracting gold and silver from their ores.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1908	9,600	$14,400
1895	1,900	47,500	1909	7,712	11,593
1896	3,000	65,000	1910	8,125	11,862
1897	5,000	110,000	1911	9,023	52,887
1898	7,000	154,000	1912	7,200	37,094
1899	10,000	250,000	1913	1,861	24,936
1900	1,000	50,000	1914	6,522	115,396
1901	8,000	400,000	1915	5,799	83,485
1902	7,000	50,000	1916	10,593	264,825
1903	18,000	27,000	1917	24,505	928,578
1904	12,000	18,000	1918	20,447	855,423
1905	15,000	22,500			
1906	12,000	18,000	Totals	212,817	$3,632,479
1907	----------	----------			

CHAPTER SEVEN.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES.

Introductory.

The state of California includes a total area of 158,360 square miles, of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum, 148 miles; and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. Some mineral of commercial value exists in every county, and during 1918 active production was reported to the State Mining Bureau from fifty-six counties of the fifty-eight. In the mountainous portions of the state are largely found the vein-forming minerals. In the desert regions of southeastern California ancient lake beds afford supplies of saline deposits. Underlying the interior valleys of the central and southern portion of the state are the large crude-oil reservoirs. Building stones and mineral earths of all descriptions are widely distributed throughout the length and breadth of the state.

Of the first ten counties in point of total output for 1918, five (Kern, Orange, Fresno, Los Angeles, Santa Barbara) owe their position mainly to petroleum. Kern, due to its oil, leads all the others by nearly three times the total of Orange, its nearest competitor. Shasta owes its rank to copper, gold, silver, zinc and pyrite; San Bernardino, its place on account of potash, tungsten, cement and copper; Inyo, mainly to borax, lead, tungsten and soda; and the next five counties, Yuba, Amador, Nevada, Plumas, Calaveras, mainly to gold, except Plumas, which is mainly copper and gold. Twenty-four counties have each a total in excess of a million dollars, for 1918. Cement is an important item in eight of these counties.

In point of variety and diversity, San Bernardino County leads all the others with a total of 25 different mineral products on its commercial list, followed by Riverside with 18, Shasta with 16, Kern with 15, and Inyo with 13.

The counties with their mineral resources, production for 1918, etc., are considered in detail in this chapter.

Value of California Mineral Production, by Counties, for 1918, Arranged in the Order of Their Importance.

County	Value
1. Kern	$63,410,685
2. Orange	22,914,660
3. Fresno	19,876,625
4. Los Angeles	16,006,628
5. Santa Barbara	10,051,831
6. Shasta	8,098,671
7. San Bernardino	7,632,790
8. Inyo	5,177,676
9. Yuba	3,844,885
10. Amador	3,452,640
11. Nevada	3,301,651
12. Plumas	3,092,694
13. Calaveras	2,794,452
14. Santa Cruz	2,599,717
15. Ventura	2,186,311
16. Sacramento	2,102,597
17. San Diego	1,942,150
18. Santa Clara	1,759,568
19. Riverside	1,689,042
20. Napa	1,676,367
21. San Benito	1,537,463
22. Solano	1,470,726
23. Contra Costa	1,324,251
24. Alameda	1,173,535
25. El Dorado	959,286
26. Placer	903,520
27. Siskiyou	877,287
28. Butte	873,035
29. San Luis Obispo	858,679
30. Trinity	707,524
31. Tuolumne	602,278
32. San Joaquin	601,973
33. Sonoma	586,391
34. Tulare	527,408
35. Stanislaus	453,913
36. Del Norte	371,675
37. Mariposa	352,504
38. Sierra	331,501
39. Lake	215,876
40. San Mateo	193,812
41. Marin	176,183
42. Tehama	157,591
43. Humboldt	141,954
44. Monterey	119,687
45. Madera	114,327
46. Imperial	109,692
47. Mendocino	108,388
48. Glenn	89,699
49. Merced	74,849
50. Mono	54,863
51. Yolo	21,215
52. San Francisco	16,463
53. Colusa	16,400
54. Kings	9,229
55. Modoc	8,220
56. Lassen	800
57. Alpine	------------
58. Sutter	------------
Total	$199,753,837

ALAMEDA.

Area: 843 square miles.

Population: 359,000 (estimate by Chamber of Commerce, 1914).

Alameda County, while in no sense one of the 'mining counties,' comes twenty-fourth on the list with a value of mineral products for 1918 of $1,173,535, an increase from the 1917 total, which was $1,138,723. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	220 tons	$14,600
Brick and tile		258,812
Clay (pottery)	2,675 tons	3,850
Manganese	2,746 tons	109,874
Pyrite	9,113 tons	45,565
Salt	130,132 tons	410,345
Stone, miscellaneous		311,320
Other minerals*		19,169
Total value		$1,173,535

*Includes asbestos, magnesium salts, potash, and limestone.

ALPINE.

Area: 776 square miles.

Population: 309 (1910 census).

Alpine has in the past shown a small production of gold and silver, but dropped out of the list of producing counties in 1914.

This county lies just south of Lake Tahoe, in the high Sierra Nevada range of mountains. Transportation is by wagon or mule back, and facilities in general are lacking to promote development work of any kind.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.

Population: 11,000 (estimate by County Clerk, 1914).

The value of Amador County's mineral production decreased slightly from $3,851,194 in 1917, to $3,452,640, dropping back to tenth place on the list of counties in the state as regards total value of mineral substances marketed. This was due to a decrease in gold output.

Although having an output consisting of 13 different minerals, the leading product, gold, makes up over 94% of the entire total. Amador led the state in gold production in 1915, but was slightly exceeded in 1917 by Nevada and Yuba counties, and by Yuba in 1918.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, lime, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	88 tons	$4,400
Clay (pottery)	13,562 tons	34,346
Gold		3,249,385
Silica	13,747 tons	61,724
Silver		29,590
Stone, miscellaneous		6,500
Other minerals*		66,695
Total value		$3,452,640

*Includes brick, coal, copper, manganese, mineral paint, platinum, and soapstone.

BUTTE.

Area: 1,722 square miles.

Population: 31,000 (estimate by Chamber of Commerce, 1914).

Location: North-central portion of state.

Butte, twenty-eighth county in California in regard to the value of its mineral output, reported a commercial production of nine mineral substances, having a total value of $873,035, as compared with $1,130,259 for 1917, the decrease being due to gold. As will be noted in the following tabulation, gold is by far the most important item. Butte stands sixth among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum minerals, silver and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	3,325 tons	$134,535
Diamonds		125
Gold		645,975
Mineral water	3,900 gals.	1,680
Platinum	114 ounces	7,723
Silver		2,410
Stone, miscellaneous		77,822
Other minerals*		2,765
Total value		$873,035

*Includes manganese and natural gas.

CALAVERAS.

Area: 1,027 square miles.

Population: 9,171 (1910 census).

Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of 9 different minerals, valued at $2,794,452 during the year 1918, as compared with the 1917 output worth $3,717,150. Gold, copper, chromite and silver are the chief mineral substances produced. In regard to total value of mineral output Calaveras stands thirteenth among the counties of the state; it is fifth in gold, third in copper, and fourth in silver, having been passed by Plumas in copper and silver output for 1918. The decrease, as compared with 1917, is due to gold and copper.

The principal mineral resources developed and undeveloped are: Asbestos, barytes, chromite, clay, copper, fuller's earth, gold, graphite, limestone, marble, mineral paint, mineral water, platinum minerals, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1918 was as follows:

Substance	Amount	Value
Chromite	3,830 tons	$159,453
Copper	6,762,882 lbs.	1,670,432
Gold		871,263
Mineral water	10,938 gals.	6,069
Platinum	10 ounces	598
Silver		84,150
Stone, miscellaneous		420
Other minerals*		2,067
Total value		$2,794,452

*Includes asbestos and lead.

COLUSA.

Area: 1,140 square miles.

Population: 7,882 (estimate by Chamber of Commerce, 1914).

Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1918 production was $16,400, a slight increase over the 1917 figures of $16,321, giving it fifty-third place.

Substance	Amount	Value
Stone, miscellaneous		$700
Other minerals*		15,700
Total value		$16,400

*Includ s chromite, mineral paint, and mineral water.

CONTRA COSTA.

Area: 714 square miles.

Population: 52,500 (estimate by Chamber of Commerce, 1914).

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral-producing counties of the state. It stands twenty-third on the list in this respect, however, with an output valued at $1,324,251 for the calendar year 1918. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick		$148,831
Clay (pottery)	100 tons	300
Mineral water	30,376 gals.	3,038
Stone, miscellaneous		324,884
Other minerals*		847,198
Total value		$1,324,251

*Includes cement and copper.

DEL NORTE.

Area: 1,024 square miles.

Population: 2,417 (1910 census).

Location: Extreme northwest corner of state.

Transportation: Wagon and mule back; steamer from Crescent City.

Del Norte rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a wide field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, graphite, iron, platinum minerals, silver, and miscellaneous stone. The increase in 1918 over the 1917 figure of $104,340 was due to chromite.

Commercial production for 1918, giving it thirty-sixth place, was as follows:

Substance	Amount	Value
Chromite	7,143 tons	$360,485
Gold		565
Platinum	1 ounce	97
Silver		4
Stone, miscellaneous		8,000
Other minerals		2,524
Total value		$371,675

EL DORADO.

Area: 1,753 square miles.

Population: 8,000 (estimate by County Clerk, 1914).

Location: East-central portion of the state; northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes twenty-fifth on the list of counties ranked according to the value of their total mineral production during the year 1918. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. Chromite and limestone both showed important increases for 1918.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, glass-sand, slate, soapstone, silver and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	11,936 tons	$674,856
Copper	22,259 lbs.	5,498
Gold		28,352
Limestone	96,673 tons	218,120
Silver		722
Stone, miscellaneous		20,500
Other minerals*		11,236
Total value		$959,286

*Includes pyrite, silica and soapstone.

FRESNO.

Area: 5,950 square miles.

Population: 120,000 (estimate by Board of Supervisors, 1914).

Location: South-central portion of state.

Fresno County, third in importance as a mineral producer among the counties of California, reported an output for 1918 of ten mineral substances, with a total value of $19,876,625, an increase over the reported 1917 production, which was worth $14,158,052. The great bulk of the above is derived from the petroleum production of the Coalinga field.

The mineral resources of this county are many, and, aside from crude oil, are in the main not yet fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, iron, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	2,314 tons	$86,181
Brick		89,156
Gold		4,795
Granite		26,800
Magnesite	1,795 tons	16,151
Natural gas	5,009,327 M cu. ft.	267,123
Petroleum	16,068,919 bbls.	19,138,083
Quicksilver	35 flasks	3,652
Silver		37
Stone, miscellaneous		244,647
Total value		$19,876,625

GLENN.

Area: 1,259 square miles.

Population: 7,172 (1910 census).

Location: West side of Sacramento Valley.

Glenn County, standing forty-eighth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	1,129 tons	$57,263
Stone, miscellaneous		32,436
Total value		$89,699

HUMBOLDT.

Area: 3,634 square miles.

Population: 37,500 (estimate by Chamber of Commerce, 1914).

Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by wagon road and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick,

chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Twelve mineral substances, as shown by the table given below, having a total value of $141,954, were produced in 1918, as compared with the 1917 output, worth $59,808, the increase being due to manganese and chromite. Humboldt ranks forty-third among the counties of the state for the year.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	370 tons	$21,744
Clay (pottery)	210 tons	420
Gold		8,028
Granite		116
Manganese	1,520 tons	57,751
Natural gas	640 M cu. ft.	85
Platinum	2 ounces	140
Silver		72
Stone, miscellaneous		51,082
Other minerals*		2,516
Total value		$141,954

*Includes brick, mineral water, and pumice.

IMPERIAL.

Area: 4,089 square miles.

Population: 50,000 (estimate by Chamber of Commerce, 1914).

Location: Extreme southeast corner of the state.

During 1918 Imperial County produced eight mineral substances having a total value of $109,692, as compared with the 1917 output, worth $129,400. Its rank is forty-sixth. This county contains deposits of gold, gypsum, lead, marble, pumice, salt, silver, and strontium, largely undeveloped.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick and tile		$11,670
Gold		247
Manganese	1,241 tons	46,900
Silver		1,248
Stone, miscellaneous		34,787
Other minerals*		14,840
Total value		$109,692

*Includes copper, lead, and pumice.

INYO.

Area: 10,019 square miles.

Population: 7,500 (estimate by Chamber of Commerce, 1914).

Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1918 reached a value of $5,177,676, standing eighth among the counties of the state in this respect. The 1917 value was $6,296,230, the decrease being due mainly to lead and soda. Its mineral resources include antimony, asbestos, barytes, bismuth, borax, copper, gems, gold, gypsum, lead, magnesite, marble, molybdenum, mineral water, nitre, platinum, pumice, quicksilver, salt, silver, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Copper	338,518 lbs.	$83,614
Dolomite	14,390 tons	32,056
Gold		100,240
Lead	12,223,471 lbs.	867,866
Silver		441,548
Talc	9,635 tons	72,549
Stone, miscellaneous		5,000
Tungsten concentrates	589 tons	854,025
Zinc	2,517,045 lbs.	229,051
Other minerals*		2,491,727
Total value		$5,177,676

*Includes borax, limestone, salt, and soda.

KERN.

Area: 8,003 square miles.

Population: 50,000 (estimate by Board of Supervisors).

Location: South-central portion of state.

Kern County, because of its immense, productive oil fields, stands pre-eminent among all counties of California in the value of its mineral output, the exact figures for 1918 being $63,410,685. This is larger by more than forty million dollars than the succeeding county on the list. This figure also is over 3 times the value of the total gold output

of the entire state for 1918. The 1917 mineral output for Kern County was worth $49,743,422. The great increase was due to the enhanced prices for crude oil of all grades.

Among the mineral resources, developed and undeveloped, of this section are: Antimony, asbestos, asphalt, barytes, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur and tungsten.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick	1,678 M	$16,380
Copper	95,580 lbs.	23,608
Gold		246,127
Lime	23,615 bbls.	23,615
Natural gas	23,545,128 M cu. ft.	1,507,912
Petroleum	49,049,917 bbls.	61,410,496
Silver		7,817
Stone, miscellaneous		311
Other minerals*		174,419
Total value		$63,410,685

*Includes lead, limestone, magnesite, mangan se, quicksilver, salt, and tungsten.

KINGS.

Area: 1,159 square miles.

Population: 23,500 (estimate by Chamber of Commerce, 1914).

Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way, but there has, as yet, been no commercial output recorded.

In fifty-fourth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Natural gas	2,460 M cu. ft.	$590
Other minerals		8,639
Total value		$9,229

LAKE.

Area: 1,278 square miles.

Population: 5,600 (estimate by Chamber of Commerce, 1914).

Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production

being comparatively small, as shown by the table below, and composed mainly of quicksilver, chromite and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In thirty-ninth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	476 tons	$24,790
Mineral water	87,067 gals.	15,006
Quicksilver	1,540 flasks	172,173
Stone, miscellaneous		1,000
Other minerals*		2,907
Total value		$215,876

*Includes manganese and natural gas.

LASSEN.

Area: 4,531 square miles.

Population: 7,000 (estimate by County Clerk, 1914).

Location: Northeast portion of state.

Lassen County is one of the little explored sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold has been produced, but not during the last two or three years.

In fifty-sixth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$800

LOS ANGELES.

Area: 4,067 square miles.

Population: 800,000 (estimate by Chamber of Commerce, 1913).

Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1918 amounted in value to $16,006,628, as compared with the 1917 output, worth $8,204,523. This county ranked fourth in the state as a mineral producer in 1918, passing Shasta, which was fourth in 1917. The advance was due to the large increase in the petroleum valuation.

Its output of brick and tile was nearly a million dollars, and that of petroleum amounted to over thirteen million dollars. Among its mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash is obtained from kelp.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick	48,381 M	$668,676
Tile	18,630 tons	121,903
Clay (pottery)	12,634 tons	11,820
Mineral water	110,481 gals.	15,540
Natural gas	2,088,959 M	224,279
Petroleum	10,125,190 bbls.	13,567,755
Potash	2,380 tons	462,600
Stone, miscellaneous		547,190
Other minerals*		386,865
Total value		$16,006,628

*Includes borax, g ms, graphite, magnesium chloride, manganese, salt, and serpentine.

MADERA.

Area: 2,112 square miles.

Population: 12,000 (estimate by Chamber of Commerce, 1914).

Location: East-central portion of state.

Madera County produced five mineral substances during the year 1918, having a total value of $114,327, as compared with the 1917 output, worth $236,937. The decrease is due to a dropping off in the output of copper and granite. This county contains deposits of copper, gold, iron, lead, molybdenum, pumice, silver, and building stone.

In forty-fifth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Copper	245,519 lbs.	$60,643
Gold		7,583
Granite		40,355
Silver		4,206
Stone, miscellaneous		1,540
Total value		$114,327

MARIN.

Area: 529 square miles.

Population: 28,400 (estimate by Chamber of Commerce, 1914).

Location: Adjoins San Francisco on the north.

Mineral production in Marin County during the year 1918 reached a value of $176,183, as compared to the 1917 output, worth $272,302. This county is not especially prolific in minerals, although among its

resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In forty-first place, commercial production for 1918 was:

Substance	Amount	Value
Stone, miscellaneous		$89,458
Other minerals*		86,725
Total value		$176,183

*Includes brick, copper, gold, mineral water, and silver.

MARIPOSA.

Area: 1,463 square miles.

Population: 3,956 (1910 census).

Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but thirty-seventh on the list of counties in regard to the value of its mineral output for 1918, with a total of $352,504, as compared wih the 1917 figures of $352,227.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Copper	30,294 lbs.	$7,483
Gold		337,682
Silver		5,083
Stone, miscellaneous		400
Other minerals*		1,856
Total value		$352,504

*Includes chromite and lead.

MENDOCINO.

Area: 3,453 square miles.

Population: 27,000 (estimate by Chamber of Commerce, 1914).

Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1918 output being valued at $108,388, ranking it forty-seventh among the counties. That of 1917 was worth $50,415. The increase is due to chromite and manganese.

Deposits of undetermined value, of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold and silver.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	555 tons	$44,200
Manganese	1,432 tons	58,962
Stone, miscellaneous		5,000
Other minerals*		226
Total value		$108,388

*Includes gold and platinum.

MERCED.

Area: 1,995 square miles.

Population: 20,000 (estimate by Chamber of Commerce, 1914).

Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley, and it figures as one of the lesser mineral-producing counties of the state. The 1918 mineral output was valued at $74,849. The decrease from the value of $147,116 in 1917 was due to gold. Gold, platinum, and silver, obtained by dredging, are among the important items. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-ninth place, commercial production during 1918 was as follows:

Substance	Amount	Value
Gold		$41,089
Silver		254
Stone, miscellaneous		32,500
Other minerals		1,006
Total value		$74,849

MODOC.

Area: 3,823 square miles.

Population: 6,191 (1910 census).

Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only recently had the benefit of communication with the outside world by rail. Among its known mineral resources are: Clay, coal, gold, iron, quicksilver, salt, and silver.

In fifty-fifth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$200
Other minerals*		8,020
Total value		$8,220

*Includes gold, salt, and silver.

MONO.

Area: 3,030 square miles.

Population: 2,100 (estimate by County Clerk, 1914).

Location: Is bordered by the state of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a rather inaccessible country and has been but superficially explored. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In fiftieth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Copper	160 lbs.	$40
Gold		31,252
Lead	1,318 lbs.	94
Silver		22,727
Other minerals		750
Total value		$54,863

MONTEREY.

Area: 3,330 square miles.

Population: 25,250 (estimate by Chamber of Commerce, 1914).

Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced nine mineral substances during the year 1918, having a total value of $119,687, as compared with the 1917 output worth $138,786. Its mineral resources include brick, clay, copper, coal, dolomite, feldspar, fuller's earth, gold, silver, gypsum, infusorial earth, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In forty-fourth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Dolomite	4,900 tons	$25,950
Feldspar	700 tons	3,800
Stone, miscellaneous		52,697
Other minerals*		37,240
Total value		$119,687

*Includes barytes, coal, diatomaceous earth, quicksilver, salt, and silica.

NAPA.

Area: 783 square miles.

Population: 26,500 (estimate by Chamber of Commerce, 1914).

Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and quicksilver, stands twenty-first on the list of mineral-producing counties in California. Its mineral resources include copper, cement, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone.

In 1918, the value of the output increased to $1,676,367 from the 1917 figure of $1,421,073, due mainly to quicksilver and cement.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	667 tons	$38,432
Magnesite	29,163 tons	263,367
Mineral water	92,512 gals.	59,620
Quicksilver	1,297 flasks	143,850
Stone, miscellaneous		82,944
Other minerals*		1,088,154
Total value		$1,676,367

*Includes c ment, gold, and silver.

NEVADA.

Area: 974 square miles.

Population: 15,500 (estimate by Chamber of Commerce, 1914).

Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, has, in recent years, alternated with Amador in the gold lead, but both were passed by Yuba in 1918. Nevada County stands eleventh on the list in regard to the value of its total mineral output, with a figure of $3,301,651, as compared with the 1917 production worth $3,838,397. The decrease is due mainly to gold. Chromite showed an increase.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	3,328 tons	$116,933
Copper	42,203 lbs.	10,424
Gold		3,070,453
Silver		72,557
Stone, miscellaneous		1,400
Other minerals*		29,884
Total value		$3,301,651

*Includes asbestos, lead, manganese, platinum, and tungsten concentrates.

ORANGE.

Area: 795 square miles.

Population: 56,500 (estimate by Chamber of Commerce, 1914).

Location: South-western portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral-producing section. It stands, however, as the second county in the state in regard to the total value of mineral output for 1918, its highly productive oil fields making such a condition possible.

This county, in company with the other oil counties, shows a gain in 1918, with a total value of mineral products of $22,914,660 from the 1917 output, worth $15,231,626. It thus passed Shasta County in 1917, which previously for a number of years, had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick	477 M	$3,869
Clay (pottery)	3,649 tons	4,650
Natural gas	10,420,171 M cu. ft.	693,169
Petroleum	15,730,462 bbls.	22,211,412
Stone, miscellaneous		1,560
Total value		$22,914,660

PLACER.

Area: 1,395 square miles.

Population: 18,237 (1910 census).

Location: Eastern border of state directly west of Lake Tahoe.

While standing only twenty-sixth on the list of mineral-producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products are gold, chromite, granite, copper, and clay. Other mineral resources are: Asbestos, brick, chromite, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	4,963 tons	$276,765
Brick and tile		81,408
Clay (pottery)	29,348 tons	29,348
Copper	837,527 lbs.	206,869
Gold		230,190
Granite		30,882
Silver		22,432
Stone, miscellaneous		4,266
Other minerals*		21,360
Total value		$903,520

*Includes manganese and silica.

PLUMAS.

Area: 2,594 square miles.

Population: 5,259 (1910 census).

Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Lack of transportation and other facilities have retarded its growth, but its future is decidedly promising. Mineral production for 1918 was valued at $3,092,694, as compared with the 1917 output, worth $2,294,886, the increase being due to copper and silver, which advanced the county from thirtieth to twelfth place in rank.

Among its mineral resources are: Chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Copper	11,098,016 lbs.	$2,741,210
Gold		125,207
Manganese	1,544 tons	61,754
Silver		156,750
Stone, miscellaneous		7,750
Other minerals		23
Total value		$3,092,694

RIVERSIDE.

Area: 7,240 square miles.

Population: 45,000 (estimate by County Clerk, 1914).

Location: Southern portion of state.

Riverside is the fourth county in the state in size and the nineteenth in regard to the total value of mineral output for 1918. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials,

and salines, some of the more important being borax, brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, glass-sand, soapstone, silver, miscellaneous stone, and tin.

The increase in 1918 over the 1917 value of $1,580,555 is due mainly to brick and tile.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick and tile		$296,540
Clay (pottery)	48,195 tons	80,454
Copper	19,485 lbs.	4,813
Feldspar	2,288 tons	11,733
Gold		392
Granite		3,326
Manganese	3,791 tons	152,694
Silica	1,400 tons	4,800
Silver		1,541
Stone, miscellaneous		127,962
Other minerals*		1,004,787
Total value		$1,689,042

*Includes cement, fluorspar, gems, gypsum, lead, magnesite, mineral water, and potash.

SACRAMENTO.

Area: 983 square miles.

Population: 90,000 (estimate by Chamber of Commerce, 1913).

Location: North-central portion of state.

Sacramento stands sixteenth among the counties of the state as a mineral producer, the output, principally gold, for 1918 being valued at $2,102,597, as compared with the 1917 production, worth $2,286,656. In regard to gold output alone this county ranks fourth, being exceeded only by Yuba, Amador, and Nevada counties. Its mineral resources include: Brick, clay, gold, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick and tile		$79,312
Gold		1,694,724
Silver		4,637
Stone, miscellaneous		262,689
Other minerals*		61,235
Total value		$2,102,597

*Includes natural gas, platinum, and potash.

SAN BENITO.

Area: 1,392 square miles.

Population: 8,750 (estimate by County Clerk, 1914).

Location: West-central portion of state.

Although twenty-first among the counties of the state in regard to value of total mineral production, San Benito leads in one important branch of the mineral industry, namely, quicksilver.

Its other mineral resources, many of them undeveloped, include: Antimony, bituminous rock, chromite, coal, gypsum, gems, limestone, mineral water, soapstone, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	130 tons	$7,000
Dolomite	5,000 tons	20,625
Magnesite	5,340 tons	48,060
Quicksilver	10,715 flasks	1,234,027
Stone, miscellaneous		103,295
Other minerals*		124,456
Total value		$1,537,463

*Includes cement, manganese, and mineral water.

SAN BERNARDINO.

Area: 20,157 square miles.

Population: 53,000 (estimate by board of supervisors, 1914).

Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state, in area, ranks seventh as regards the value of its mineral output for 1918 with a total of $7,632,790, as compared with the 1917 total of $7,407,742. The increase is due mainly to potash, in spite of the considerable decrease in tungsten value.

San Bernardino leads all other counties in the state in point of variety of minerals produced commercially during 1918, there being 25 different substances on its list, against 16 for its nearest competitor, Shasta County.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, glass-sand, silver, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Cement	1,027,635 bbls.	$1,453,962
Copper	1,580,998 lbs.	390,507
Dolomite	270 tons	810
Gold		29,225
Lead	667,978 lbs.	47,426
Limestone	10,852 tons	13,323
Mineral water	601,500 gals.	60,150
Potash	27,545 tons	3,428,443
Silver		88,712
Talc	430 tons	4,210
Stone, miscellaneous		48,451
Strontium	2,900 tons	33,000
Tungsten concentrates	1,347 tons	1,911,966
Zinc	2,824 lbs.	257
Other minerals*		122,348
Total value		$7,632,790

*Includes gems, granite, gypsum, iron ore, lime, magnesite, manganese, marble, mineral paint, and salt.

SAN DIEGO.

Area: 4,221 square miles.

Population: 125,379 (estimate by County Clerk, 1914).

Location: Extreme southwest corner of state.

San Diego ranks seventeenth in the total value of its mineral output. This figure for 1918 equaled $1,942,150, as compared with the 1917 output worth $1,713,708, the advance being due to potash. For the first time in several years, there was no production of gems, in which San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash is produced from kelp.

A development of the past three years is the shipping of pebbles for grinding mills.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Brick and tile		$29,080
Copper	4,143 lbs.	1,023
Feldspar	700 tons	3,600
Potash	10,392 tons	1,578,874
Salt	10,631 tons	61,717
Stone, miscellaneous		184,158
Other minerals*		83,698
Total value		$1,942,150

*Includes granite, lithia, and mineral water.

SAN FRANCISCO.

Area: 43 square miles.

Population: 527,000 (estimate by Chamber of Commerce, 1915).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting of crushed rock, sand, and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities.

In fifty-second place, commercial production for 1918 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$16,463

SAN JOAQUIN.

Area: 1,448 square miles.

Population: 70,000 (estimate by Chamber of Commerce, 1914).

Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1918 having a total value of $601,973, as compared with the 1917 output, worth $470,220, the increase being due mainly to brick and gold. Comparatively few mineral substances are found here, the chief ones being brick, clay, infusorial earth, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver, are obtained by dredging in the Mokelumme River, which forms the boundary between this county and Amador on the northeast.

In thirty-second place, commercial production for 1918 was as follows:

Substance	Amount	Value
Brick		$305,475
Manganese	4,281 tons	117,709
Natural gas	202,453 M cu. ft.	60,405
Stone, miscellaneous		47,085
Other minerals*		71,299
Total value		$601,973

*Includes gold, platinum and silver.

SAN LUIS OBISPO.

Area: 3,334 square miles.

Population: 25,000 (estimate by Chamber of Commerce, 1914).

Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1918 was $858,679, as compared with the 1917 output, worth $338,144,

the increase being due to chromite. Among its mineral resources, both developed and undeveloped, are: Asphalt, bituminous rock, brick, chromite, coal, copper, gypsum, infusorial earth, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, and miscellaneous stone.

In twenty-ninth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	10,443 tons	$539,423
Manganese	1,907 tons	81,926
Petroleum	62,744 bbls.	56,783
Stone, miscellaneous		6,100
Other minerals*		174,447
Total value		$858,679

*Includes bituminous rock, copp r, gold, mineral water, quicksilver, silver, and soda.

SAN MATEO.

Area: 447 square miles.

Population: 35,000 (estimate by Chamber of Commerce, 1914).

Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone, brick, and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1918 equaled $193,812, as compared with the 1917 figures of $207,162, the decrease being due to miscellaneous stone.

Small amounts of barytes, chromite, infusorial earth and quicksilver have been noted in addition to the items of economic value given below.

In fortieth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Salt	26,434 tons	$144,604
Stone, miscellaneous		34,164
Other minerals*		15,044
Total value		$193,812

*Includes magnesium chloride and potash.

SANTA BARBARA.

Area: 2,740 square miles.

Population: 32,750 (estimate by Chamber of Commerce, 1914).

Location: South-western portion of state, joining San Luis Obispo on the south.

Santa Barbara County owes its advance to fifth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year

1918 was $10,051,831, as compared with the 1917 output of $5,153,081. Santa Barbara, in company with the other oil counties, showed an increase in petroleum valuation for 1918.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Limestone	3,790 tons	$18,830
Mineral water	73,117 gals.	97,162
Natural gas	4,150,316 M cu. ft.	338,036
Petroleum	7,334,104 bbls.	9,057,618
Potash	1,863 tons	256,780
Stone, miscellaneous		11,613
Other minerals*		271,792
Total value		$10,051,831

*Includes bituminous rock, chromite, brick, diatomaceous earth, quicksilver, and sandstone.

SANTA CLARA.

Area: 1,328 square miles.

Population: 90,000 (estimate by board of supervisors, 1914).

Location: West-central portion of state.

Santa Clara County reported a mineral output for 1918 of $1,759,568, as compared with the 1917 figures of $991,530, the increase being due to potash and manganese.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone. It stood second in quicksilver yield for the year.

In eighteenth place, commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	225 tons	$8,968
Brick		62,000
Magnesite	9,746 tons	121,872
Manganese	1,059 tons	38,301
Mineral water	13,025 gals.	1,678
Petroleum	20,499 bbls.	34,848
Quicksilver	3,977 flasks	478,524
Stone, miscellaneous		111,860
Other minerals*		901,517
Total value		$1,759,568

*Includes pottery clay, potash, and tile.

SANTA CRUZ.

Area: 435 square miles.

Population: 30,140 (estimate by Chamber of Commerce, 1914).

Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $2,599,717, giving the county a standing of fourteenth among all others in the state in this regard. The advance from seventeenth place in 1917 with a valuation of $1,668,324 was due mainly to cement, and in part to potash.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Lime	182,083 bbls.	$285,316
Limestone	7,132 tons	15,313
Stone, miscellaneous		9,107
Other minerals*		2,289,981
Total value		$2,599,717

*Includes bituminous rock, cement, and potash.

SHASTA.

Area: 3,858 square miles.

Population: 19,000 (estimate by County Clerk, 1914).

Location: North-central portion of state

Shasta County stands sixth in California among the mineral-producing counties for 1918 with an output valued at $8,098,671, as compared with the 1917 production, worth $10,244,869, the decrease being due mainly to the falling off in output of copper. Not taking petroleum into account, Shasta leads all the counties by a fair margin. This county is first in copper production, second in silver, first in pyrite, first in zinc, and seventh in gold. The Shasta copper belt contains the most important deposits of this metal yet developed on the Pacific Coast.

Shasta's mineral resources include: Asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, miscellaneaus stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	1,423 tons	$70,214
Copper	25,294,590 lbs.	6,247,764
Gold		543,509
Lead	492,565 lbs.	34,972
Limestone	45,671 tons	72,410
Platinum	35 ounces	2,709
Silver		420,410
Stone, miscellaneous		7,000
Zinc	3,045,692 lbs.	277,158
Other minerals*		422,525
Total value		$8,098,671

*Includes cadmium, brick, iron ore, lime, min'ral water, molybdenum, and pyrite.

SIERRA.

Area: 923 square miles.

Population: 4,098 (1910 census).

Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $331,501, consisting mainly of gold and silver, during the year 1918, as compared with the 1917 output, worth $389,615, the decrease being due to the falling off in gold output. Considering gold output alone, this county stands eleventh; and as to total mineral yield, thirty-eighth.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, copper, iron, lead, platinum minerals, serpentine, and talc.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	807 tons	$40,012
Gold		289,368
Silver		2,121
Total value		$331,501

SISKIYOU.

Area: 6,256 square miles.

Population: 25,000 (estimate by County Clerk, 1914).

Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks twenty-seventh in regard to the value of its mineral output for 1918. The advance in rank from thirty-ninth in 1917, was due to chromite, notwithstanding the losses in copper, gold and miscellaneous stone. Although the county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail alone. Future development and exploitation will doubtless increase the productiveness of this part of the state to a great degree.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are: Chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	6,612 tons	$336,588
Copper	573,593 lbs.	141,677
Gold		294,227
Mineral water	501,750 gals.	50,175
Platinum	1 ounce	58
Silver		14,501
Stone, miscellaneous		24,588
Other minerals*		15,473
Total value		$877,287

*Includes lead and pumice.

SOLANO.

Area: 822 square miles.

Population: 31,000 (estimate by Chamber of Commerce, 1914).

Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1918 to the total value of $1,470,726, ranking twenty-second among the counties of the state, the decrease from 1917 being due to cement. Among her mineral resources are: Brick, cement, clay, fuller's earth, limstone, mineral water, natural gas, onyx, petroleum, quicksilver, salt, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Mineral water	11,440 gals.	$2,722
Quicksilver	593 flasks	59,122
Stone, miscellaneous		30,124
Other minerals*		1,378,758
Total value		$1,470,726

*Includes cement, fuller's earth, natural gas, onyx, and salt.

SONOMA.

Area: 1,577 square miles.

Population: 48,394 (1910 census).

Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked thirty-third among the counties of California during the year 1918, with a mineral production of $586,391, as compared with its 1917 output worth $506,750, the increase being due mainly to chromite and quicksilver. More paving blocks are turned out here than in any other section of the state.

Among Sonoma's mineral resources are: Brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	1,540 tons	$73,906
Magnesite	4,110 tons	40,010
Manganese	173 tons	7,645
Mineral water	83,220 gals.	36,050
Quicksilver	2,417 flasks	280,333
Stone, miscellaneous		148,347
Other minerals		100
Total value		$586,391

STANISLAUS.

Area: 1,450 square miles.

Population: 30,000 (estimate by Board of Trade, 1914).

Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918 by manganese. Brick, clay, gypsum, iron, mineral paint, quicksilver, and silver are found here to some extent as well. This county, for 1918, ranks thirty-fifth in the state in regard to value of minerals, with an output of $453,913 as compared with $289,922 in 1917, the increase being due to chromite, magnesite, and manganese. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	1,352 tons	$56,505
Gold		114,196
Silver		592
Magnesite	2,024 tons	18,038
Manganese	5,753 tons	222,422
Mineral paint	498 tons	3,088
Stone, miscellaneous		38,764
Other minerals		308
Total value		$453,913

SUTTER.

Area: 608 square miles.

Population: 9,375 (estimate by County Clerk, 1914).

Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance.

In 1917 some crushed rock was taken out, from the Marysville Buttes, but there was no production in 1918. Both coal and clay exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA.

Area: 2,893 square miles.

Population: 14,575 (estimate by County Clerk, 1914).

Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands forty-second among the fifty-six mineral-producing counties of the state for 1918, when its output was valued at $157,591, as compared with the 1917 yield worth $44,019. The advance was due to chromite.

Among its mineral resources are listed: Brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	3,261 tons	$152,291
Stone, miscellaneous		2,500
Other minerals		2,800
Total value		$157,591

TRINITY.

Area: 3,166 square miles.

Population: 3,301 (1910 census).

Location: Northwestern portion of state.

Trinity, like Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, and copper, very little active production of these mineral substances has been made as yet. The 1918 output of $707,524 shows a decrease from the 1917 figure of $987,842, due mainly to gold, notwithstanding the increase in chromite shipped.

In thirtieth place, commercial output for 1918 was:

Substance	Amount	Value
Chromite	1,814 tons	$75,660
Gold		444,729
Platinum	41 ounces	3,136
Silver		6,912
Stone, miscellaneous		1,513
Other minerals*		175,574
Total value		$707,524

*Includes copper, mineral water, and quicksilver.

TULARE.

Area: 4,856 square miles.

Population: 35,440 (1910 census).

Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands thirty-fourth on the list of mineral-producing counties, the drop from nineteenth place in 1917, being due to the decrease in magnesite shipments. Her mineral resources, among others, are: Brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, but was passed in 1918 by Napa County.

Commercial production in 1918 was as follows:

Substance	Amount	Value
Chromite	600 tons	$24,000
Feldspar	444 tons	2,928
Limestone	8,400 tons	32,400
Magnesite	28,826 tons	269,748
Silica	204 tons	1,143
Stone, miscellaneous		125,407
Other minerals*		71,782
Total value		$527,408

*Includes brick, tile, gems, granite, soapstone and talc.

TUOLUMNE.

Area: 2,190 square miles.

Population: 9,979 (1910 census).

Location: East-central portion of state—Mother Lode district.

Tuolumne ranks thirty-first among the counties of the state relative to its total value of mineral output. As a producer of marble its standing is first. The increase in 1918 to $602,278 over the 1917 figure of $511,273 was due to chromite.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone, are among its mineral resources.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Chromite	4,269 tons	$168,693
Copper	35,127 lbs.	8,676
Gold		274,328
Limestone	3,064 tons	5,600
Silver		21,425
Stone, miscellaneous		1,700
Other minerals*		121,856
Total value		$602,278

*Includes lime, manganese, and marble.

VENTURA.

Area: 1,878 square miles.

Population: 21,000 (estimate by Chamber of Commerce, 1914).

Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the fifteenth county in the state in respect to the value of its mineral production for 1918, the exact figure being $2,186,311, as compared with the output for 1917, worth $1,498,010, the advance being due to petroleum.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are: Asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Natural gas	858,457 M cu. ft.	$150,885
Petroleum	1,339,342 bbls.	1,982,226
Stone, miscellaneous		52,900
Other minerals		300
Total value		$2,186,311

YOLO.

Area: 1,014 square miles.

Population: 15,000 (estimate by County Clerk, 1914).

Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1918 consisted mainly of quicksilver and miscellaneous stone, valued at $21,215, ranking it in fifty-first place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county.

Commercial production for 1918 was as follows:

Substance	Amount	Value
Stone, miscellaneous		$17,915
Other minerals		3,300
Total value		$21,215

YUBA.

Area: 639 square miles.

Population: 14,750 (estimate by County Clerk, 1914).

Location: Lies west of Sierra and Nevada counties: south of Plumas.

Yuba is ninth of the fifty-six mineral producing counties of the state, and leads in regard to gold output, surpassing both Nevada and Amador counties in 1918 in gold yield. Iron deposits have been reported in this county, aside from the following commercial production shown for the year 1918:

Substance	Amount	Value
Gold		$3,767,933
Platinum	189 ounces	12,930
Silver		13,796
Stone, miscellaneous		43,338
Other minerals		6,888
Total value		$3,844,885

CHAPTER EIGHT.

APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats., 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the State of California do enact as follows:

Section 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

Sec. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the State of California.

Sec. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

Sec. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to

public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devices and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau, and to exchange publications with other geological surveys and scientific societies, etc.

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

APPENDIX.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

Publications of this Bureau will be sent on receipt of the requisite amount. Only stamps, coin or money orders will be accepted in payment. The prices, noted, include delivery charges to all parts of the United States.

Money orders should be made payable to the STATE MINING BUREAU.

Personal checks will not be accepted.

REPORTS.

Asterisk (*) indicates the publication is out of print.

		Price
*Report I.	Henry G. Hanks. 1880.	
*Report II.	Henry G. Hanks. 1882.	
*Report III.	Henry G. Hanks. 1883.	
*Report IV.	Henry G. Hanks. 1884.	
*Report V.	Henry G. Hanks. 1885.	
*Report VI.	Part 1. Henry G. Hanks. 1886.	
*Report VI.	Part 2. Wm. Irelan, Jr. 1886.	
*Report VII.	Wm. Irelan, Jr. 1887.	
*Report VIII.	Wm. Irelan, Jr. 1888.	
*Report IX.	Wm. Irelan, Jr. 1889.	
*Report X.	Wm. Irelan, Jr. 1890.	
Report XI.	Wm. Irelan, Jr. 1892. (First biennial)	$1.00
*Report XII.	J. J. Crawford. 1894. (Second biennial)	----
*Report XIII.	J. J. Crawford. 1896. (Third biennial)	----
Chapters of State Mineralogist's Report, Biennial period, 1913-1914, Fletcher Hamilton:		
	Mines and Mineral Resources of Imperial and San Diego Counties.—F. J. H. Merrill. 1914	.35
	*Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties—W. B. Tucker. 1915	----
	Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties—Walter W. Bradley. 1915	.50
	Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties—F. L. Lowell. 1915	.25
	Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties—Walter W. Bradley, G. C. Brown, F. L. Lowell and R. P. McLaughlin. 1915	.50
	Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties—G. C. Brown. 1915	.50
Report XIV.	Fletcher Hamilton, 1915, Biennial period 1913-1914. (The above county chapters combined in a single volume)	2.00
Chapters of State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:		
	Mines and Mineral Resources, Alpine, Inyo and Mono Counties, with geological map—Arthur S. Eakle, Emile Huguenin, R. P. McLaughlin, Clarence A. Waring. 1917	1.25
	Same as above, without geological map	.65
	Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties—W. Burling Tucker, Clarence A. Waring. 1917	.50
	Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties—W. Burling Tucker, Clarence A. Waring. 1917	.65
	Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties—Frederick J. H. Merrill. 1917	.50
	Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties—Walter W. Bradley, Emile Huguenin, C. A. Logan, Clarence A. Waring. 1917	.65
	Mines and Mineral Resources, San Bernardino and Tulare Counties—H. C. Cloudman, Emile Huguenin, F. J. H. Merrill, W. Burling Tucker 1917	.65
Report XV.	Fletcher Hamilton, 1918, Biennial period, 1915-1916. (The above county chapters combined in a single volume)	†

BULLETINS.

*Bulletin 1.	Dessicated Human Remains.—Winslow Anderson. 1888	----
*Bulletin 2.	Methods of Mine Timbering.—W. H. Storms. 1894	----
*Bulletin 3.	Gas and Petroleum Yielding Formations of the Central Valley of California.—W. L. Watts. 1894	----
*Bulletin 4.	Catalogue of California Fossils (Parts 2, 3, 4 and 5).—J. G. Cooper. 1894	----
*Bulletin 5.	The Cyanide Process: Its Practical Application and Economical Results.—A. Scheidel. 1894	----

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PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU—Continued.

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Bulletin 6.	California Gold Mill Practices.—E. B. Preston. 1895	$0.50
*Bulletin 7.	Mineral Production of California, by Counties, 1894.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 8.	Mineral Production of California, by Counties, 1895.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 9.	Mine Drainage, Pumps, etc.—Hans C. Behr. 1896	----
*Bulletin 10.	A Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California.—A. W. Vogdes. 1896	----
*Bulletin 11.	Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties.—W. L. Watts. 1896	----
*Bulletin 12.	Mineral Production of California, by Counties, 1896.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 13.	Mineral Production of California, by Counties, 1897.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 14.	Mineral Production of California, by Counties, 1898.—Chas. G. Yale. (Tabulated sheet)	----
Bulletin 15.	Map of Oil City Oil Fields, Fresno County.—J. H. Means	----
*Bulletin 16.	The Genesis of Petroleum and Asphaltum in California.—A. S. Cooper. 1899	----
*Bulletin 17.	Mineral Production of California, by Counties, 1899.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 18.	The Mother Lode Region of California.—W. H. Storms. 1900	----
*Bulletin 19.	Oil and Gas Yielding Formations of California.—W. L. Watts. 1900	----
*Bulletin 20.	Synopsis of General Report of State Mining Bureau.—W. L. Watts. 1900	----
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*Bulletin 22.	Mineral Production of California for Fourteen Years.—Chas. G. Yale. 1900. (Tabulated sheet)	----
Bulletin	Reconnaissance of the Colorado Desert Mining District.—Stephen Bowers. 1901	----
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*Bulletin 24.	The Saline Deposits of California.—G. E. Bailey. 1902	----
*Bulletin 25.	Mineral Production of California, by Counties, 1901.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 26.	Mineral Production of California for Fifteen Years.—Chas. G. Yale. 1901. (Tabulated sheet)	----
*Bulletin 27.	The Quicksilver Resources of California.—Wm. Forstner. 1903	----
*Bulletin 28.	Mineral Production of California, by Counties, 1902.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 29.	Mineral Production of California for Sixteen Years.—Chas. G. Yale. 1902. (Tabulated sheet)	----
*Bulletin 30.	A Bibliography of Geology, Palæontology, and Mineral Resources of California.—A. W. Vogdes. 1903	----
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*Bulletin 34.	Mineral Production of California for Seventeen Years.—Chas. G. Yale. 1903. (Tabulated Sheet)	----
*Bulletin 35.	Mines and Minerals of California, for 1903.—Chas. G. Yale. 1904. (Statistical)	----
*Bulletin 36.	Gold Dredging in California.—J. E. Doolittle. 1905	----
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*Bulletin 38.	The Structural and Industrial Materials of California.—Wm. Forstner, T. C. Hopkins, C. Naramore, L. H. Eddy. 1906	----
*Bulletin 39.	Mineral Production of California, by Counties, 1904.—Chas. G. Yale. (Tabulated sheet)	----
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*Bulletin 42.	Mineral Production of California, by Counties. 1905.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 43.	Mineral Production of California for Nineteen Years.—Chas. G. Yale. 1905. (Tabulated sheet)	----
*Bulletin 44.	Mines and Minerals of California, for 1905.—Chas. G. Yale. (Statistical)	----
*Bulletin 45.	Auriferous Black Sands of California.—J. A. Edman. 1907	----
Bulletin 46.	General Index to Publications of the State Mining Bureau.—Compiled by Chas. G. Yale. 1907	.30
*Bulletin 47.	Mineral Production of California, by Counties, 1906.—Chas. G. Yale. (Tabulated sheet)	----
*Bulletin 48.	Mineral Production of California for Twenty Years.—Chas. G. Yale. 1906. (Tabulated sheet)	----

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU—Continued.

	Asterisk (*) indicates the publication is out of print.	Price.
*Bulletin 49.	Mines and Minerals of California, for 1906.—Chas. G. Yale. (Statistical)	----
Bulletin 50.	The Copper Resources of California.—A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne, J. A. Edman. 1908	$1.00
*Bulletin 51.	Mineral Production of California, by Counties, 1907.—D. H. Walker. (Tabulated sheet)	----
*Bulletin 52.	Mineral Production of California for Twenty-one Years.—D. H. Walker. 1907. (Tabulated sheet)	----
*Bulletin 53.	Mineral Production of California for 1907, with County Maps—D. H. Walker. 1908. (Statistical)	----
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*Bulletin 56.	Mineral Production for 1908, County Maps, and Mining Laws of California.—D. H. Walker. 1909. (Statistical)	----
*Bulletin 57.	Gold Dredging in California.—W. B. Winston, Charles Janin. 1910	----
*Bulletin 58.	Mineral Production of California, by Counties, 1909.—D. H. Walker. (Tabulated sheet)	----
*Bulletin 59.	Mineral Production of California for Twenty-three Years.—D. H. Walker. 1909. (Tabulated sheet)	----
*Bulletin 60.	Mineral Production for 1909, County Maps, and Mining Laws of California.—D. H. Walker. 1910. (Statistical)	----
*Bulletin 61.	Mineral Production of California, by Counties, for 1910.—D. H. Walker. (Tabulated sheet)	----
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Bulletin 63.	Petroleum in Southern California.—P. W. Prutzman. 1912	.75
*Bulletin 64.	Mineral Production for 1911.—E. S. Boalich, Statistician. 1912	----
*Bulletin 65.	Mineral Production for 1912.—E. S. Boalich. 1913	----
*Bulletin 66.	Mining Laws (United States and California). 1914	----
*Bulletin 67.	Minerals of California.—A. S. Eakle. 1914	----
*Bulletin 68.	Mineral Production for 1913.—E. S. Boalich. 1914	----
Bulletin 69.	Petroleum Industry of California, with Folio of Maps (18x22 in.) —R. P. McLaughlin and C. A. Waring. 1914	2.00
*Bulletin 70.	Mineral Production for 1914, with Mining Law Appendix. 1915.	----
*Bulletin 71.	California Mineral Production for 1915, with Mining Law Appendix and Maps.—Walter W. Bradley. 1916	----
Bulletin 72.	Geologic Formations of California.—James Perrin Smith. 1917. (For Map, see below)	.25
*Bulletin 73.	Report of Operations of Department of Petroleum and Gas for 1915-1916.—R. P. McLaughlin. 1917	----
Bulletin 74.	California Mineral Production for 1916, with County Maps.—Walter W. Bradley. 1917	----
Bulletin 75.	Mining Laws, United States and California. 1917	----
Bulletin 76.	Manganese and Chromium in California.—Walter W. Bradley, Emile Huguenin, C. A. Logan, W. Burling Tucker, C. A. Waring. 1918	.50
Bulletin 77.	Catalogue of the Publications of the California State Mining Bureau, 1880-1917.—E. S. Boalich. 1918	----
Bulletin 78.	Quicksilver Resources of California.—Walter W. Bradley. 1918	1.50
Bulletin 79.	Magnesite in California. (In preparation)	----
Bulletin 80.	Tungsten, Molybdenum and Vanadium in California. (In preparation)	----
Bulletin 81.	Copper Resources of Foothill Belt, California. (In preparation)	----
Bulletin 82.	Second Annual Report of the State Oil and Gas Supervisor, 1916-1917.—R. P. McLaughlin. 1918	----
Bulletin 83.	California Mineral Production for 1917, with County Maps.—Walter W. Bradley. 1918	----
Bulletin 84.	Third Annual Report of the State Oil and Gas Supervisor, 1917-1918.—R. P. McLaughlin. 1919	----
Bulletin 85.	Platinum Resources of California. (In press)	----
Bulletin 86.	California Mineral Production for 1918, with County Maps. Walter W. Bradley. 1919	----

PRELIMINARY REPORTS.

*Preliminary	Report No. 1. Notes on Damage by Water in California Oil Fields, Dec., 1913. By R. P. McLaughlin	----
*Preliminary	Report No. 2. Notes on Damage by Water in California Oil Fields, Mar., 1914. By R. P. McLaughlin	----
*Preliminary	Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich	----
Preliminary	Report No. 3. Manganese and Chromium. By E. S. Boalich. (Second edition)	----
Preliminary	Report No. 4. Tungsten, Molybdenum and Vanadium, 1918. By E. S. Boalich and W. O. Castello	----
Preliminary	Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium, Tin, 1918. By E. S. Boalich and W. O. Castello	----

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU—Continued.

REGISTERS OF MINES WITH MAPS.

Astrisk (*) indicates the publication is out of print.	Price.
Amador County	$.25
Butte County	.25
*Calaveras County	----
*El Dorado County	----
*Inyo County	----
*Kern County	----
*Lake County	----
Mariposa County	.25
*Nevada County	----
*Placer County	----
*Plumas County	----
*San Bernardino County	----
*San Diego County	----
Santa Barbara County	.25
*Shasta County	----
*Sierra County	----
*Siskiyou County	----
*Trinity County	----
*Tuolumne County	----
Yuba County	.25
Register of Oil Wells (with map), Los Angeles City	.35

OTHER MAPS.

	Price
*California, Showing Mineral Deposits (50x60 in.)—mounted	----
Forest Reserves in California—	
Mounted	.50
Unmounted	.30
*Mineral and Relief Map of California	----
El Dorado County, Showing Boundaries of National Forests	.20
Madera County, Showing Boundaries of National Forests	.20
Placer County, Showing Boundaries of National Forests	.20
Shasta County, Showing Boundaries of National Forests	.20
Sierra County, Showing Boundaries of National Forests	.20
Siskiyou County, Showing Boundaries of National Forests	.20
*Trinity County, Showing Boundaries of National Forests	----
Tuolumne County, Showing Boundaries of National Forests	.20
*Mother Lode Region	----
Desert Region of Southern California	.10
Minaret Region, Madera County	.20
Copper Deposits in California	.05
Calaveras County	.25
Lake County	.25
Tuolumne County	.25
Geological Map of California (mounted)—50x60 inches	2.50

OIL FIELDS MAPS.

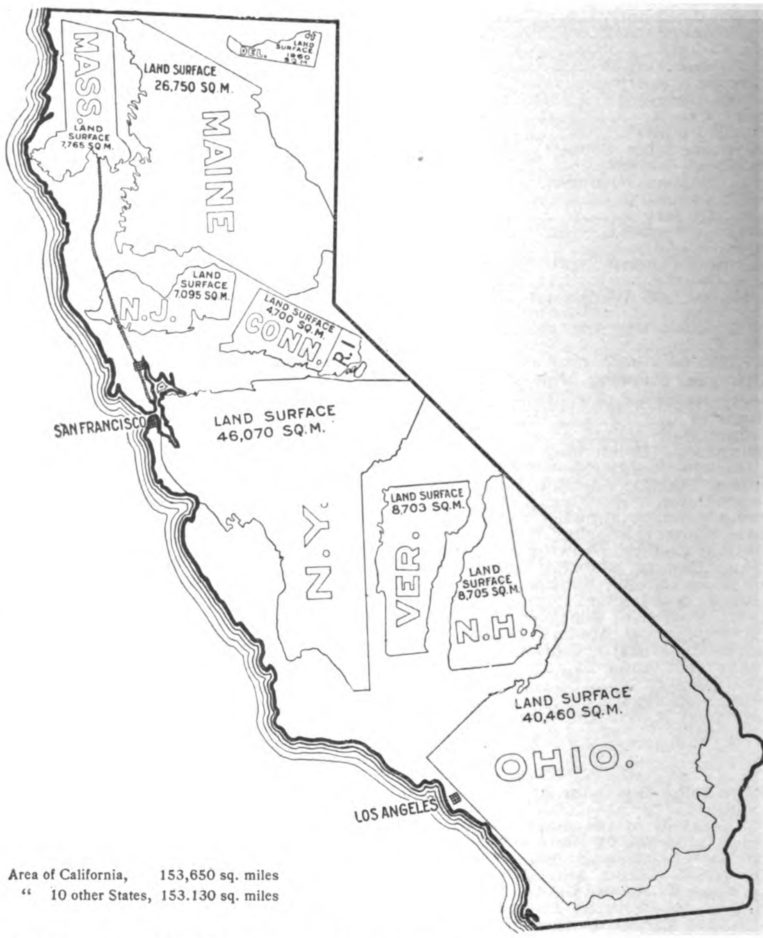
The following maps of the oil fields of the state have been completed and placed on sale:

The prices of the maps are 75 cents per copy, with the exception of the Sargent oil map, which is 50 cents. These prices include postage.

Map No. 1—Sargent, Santa Clara County.
Map No. 2—Santa Maria, including Cat Cañon and Los Alamos.
Map No. 3—Santa Maria, including Casmalia and Lompoc.
Map No. 4—Whittier-Fullerton, including Olinda, Brea Cañon, Puente Hills, East Coyote, and Richfield.
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello.
Map No. 6—Salt Lake, Los Angeles County.
Map No. 7—Sunset and San Emidio, Kern County.
Map No. 8—South Midway and Buena Vista Hills, Kern County.
Map No. 9—North Midway and McKittrick, Kern County.
Map No. 10—Belridge and McKittrick Front, Kern County.
Map No. 11—Lost Hills and North Belridge, Kern County.
Map No. 12—Devils Den, Kern County.
Map No. 13—Kern River, Kern County.
Map No. 14—Coalinga, Fresno County.
Map No. 15—Elk Hills, Kern County.

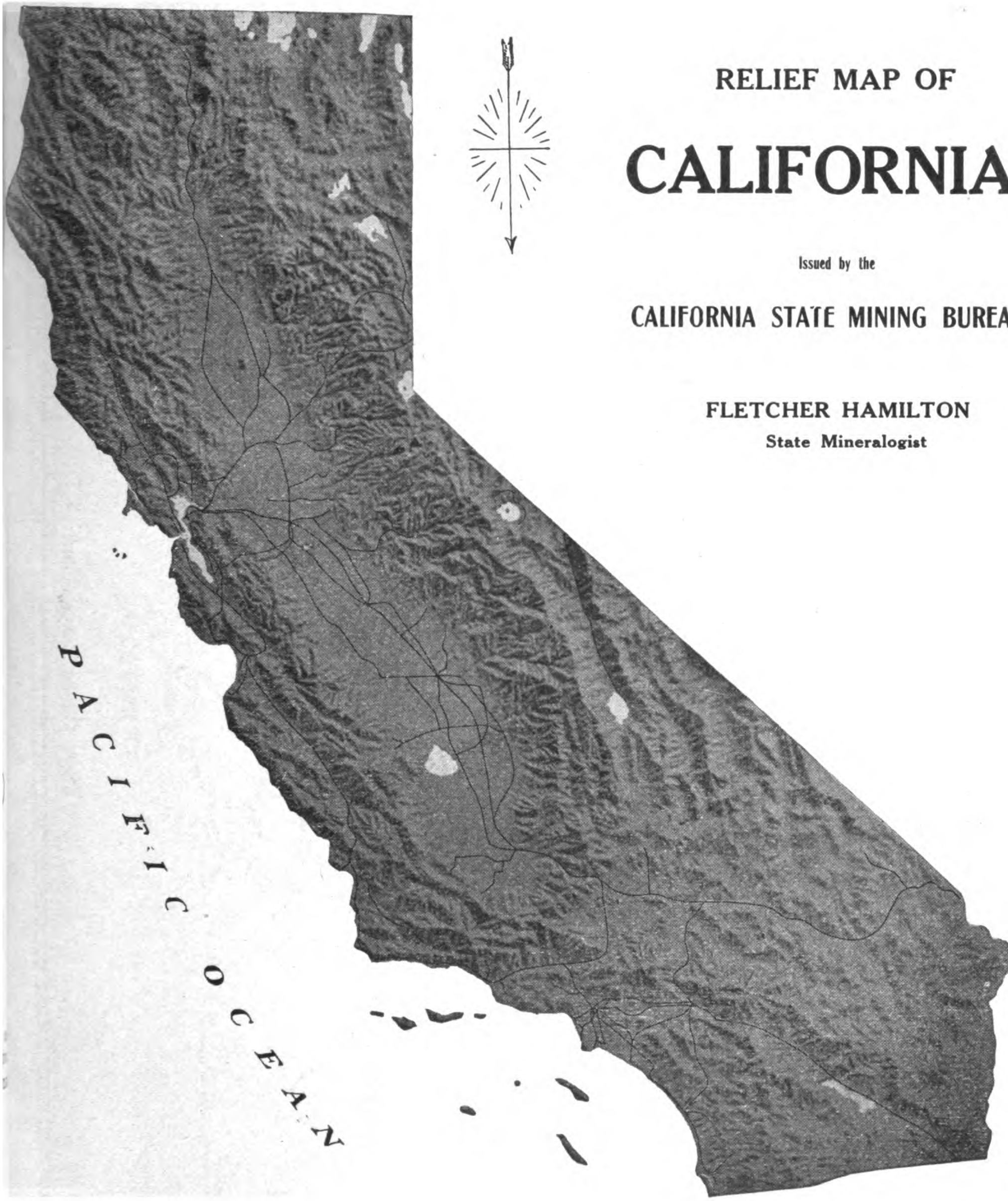
DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.



Outline map of California, showing relative areas of ten other states.

The following county maps show all towns, post offices, railroads, stage lines, and the highways. They are especially valuable to all who wish to leave the railroad and penetrate to the interior of the mining districts of the state. These maps must not be reproduced without obtaining permission from the Mining Bureau.



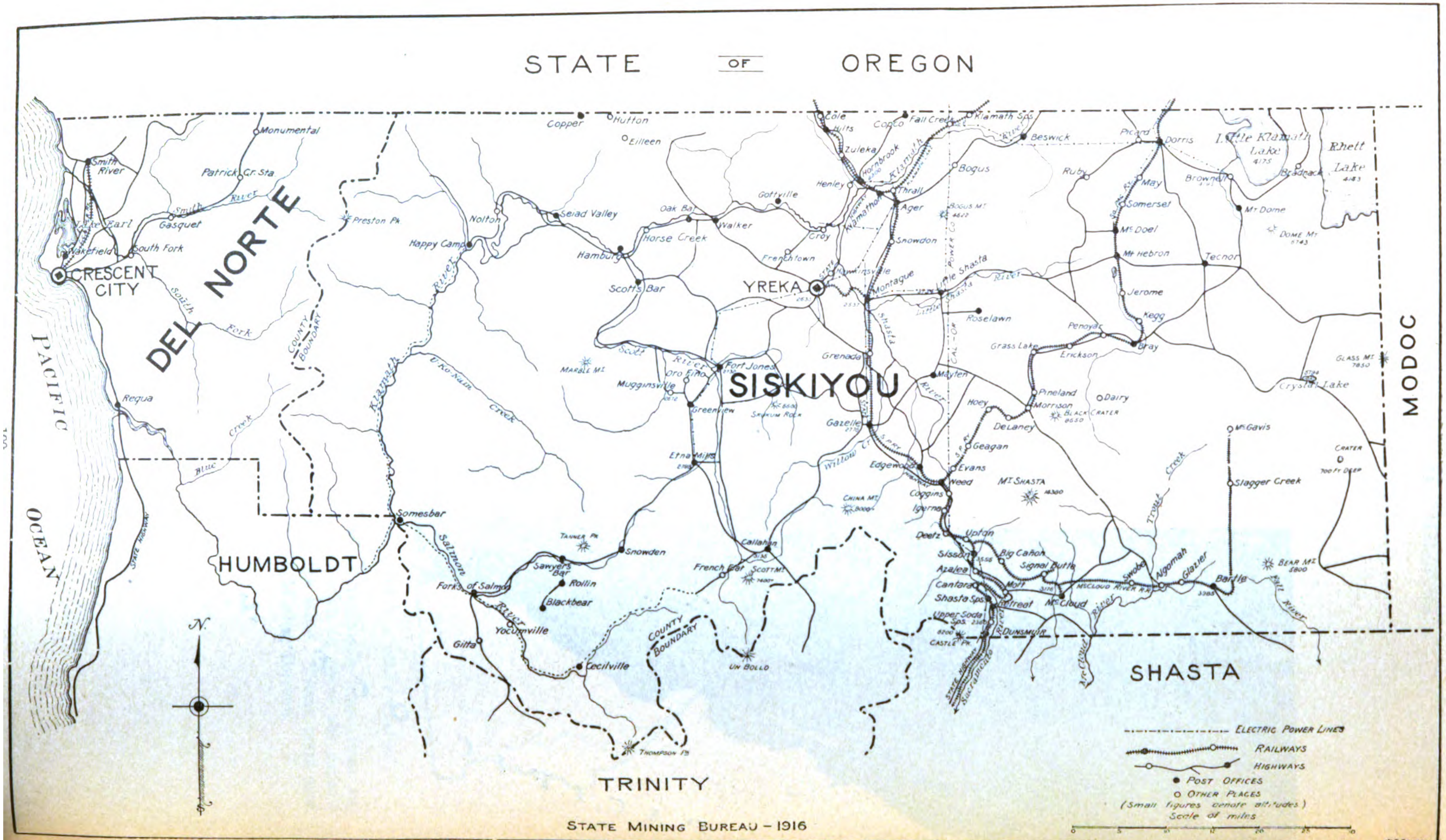
RELIEF MAP OF

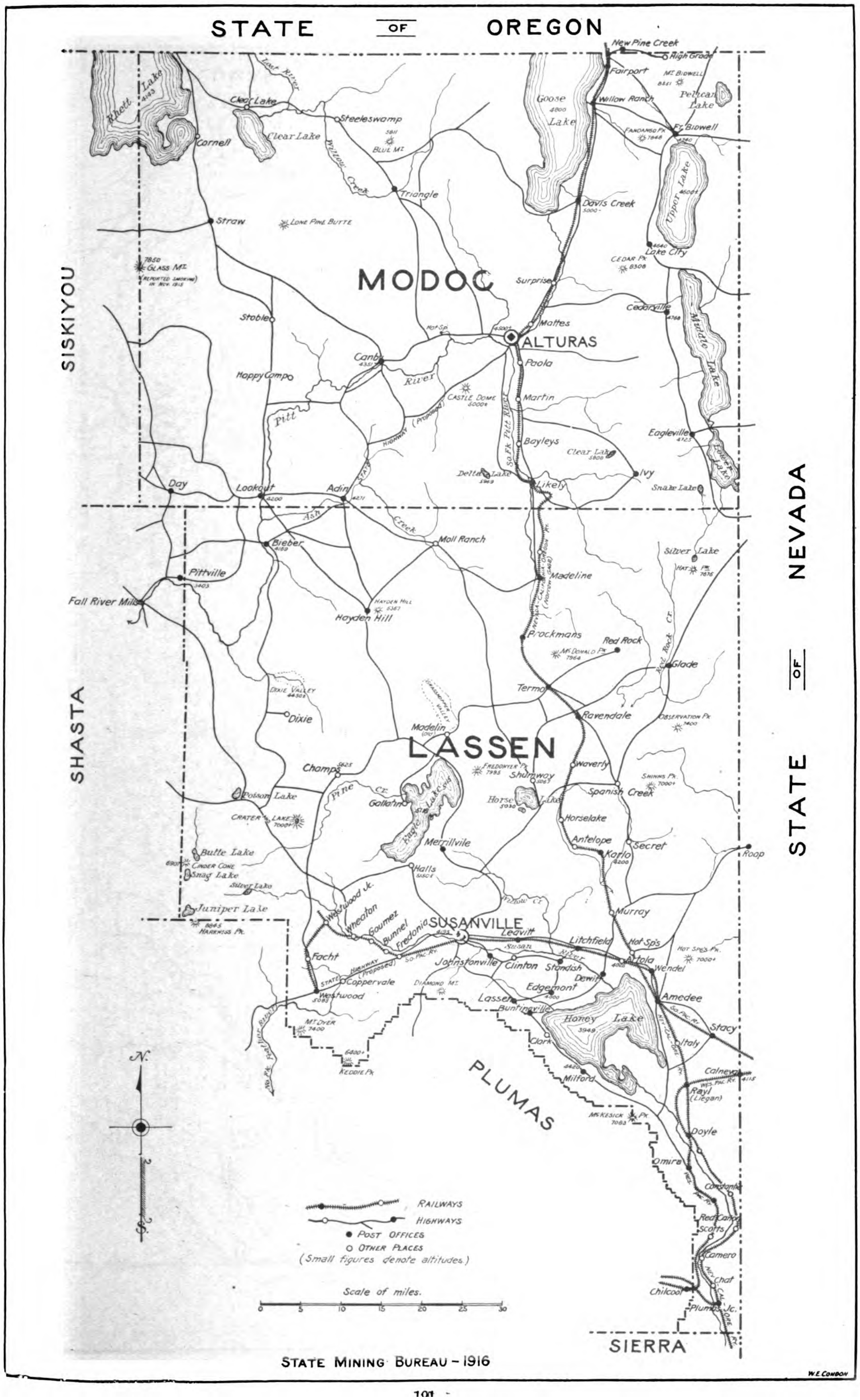
CALIFORNIA

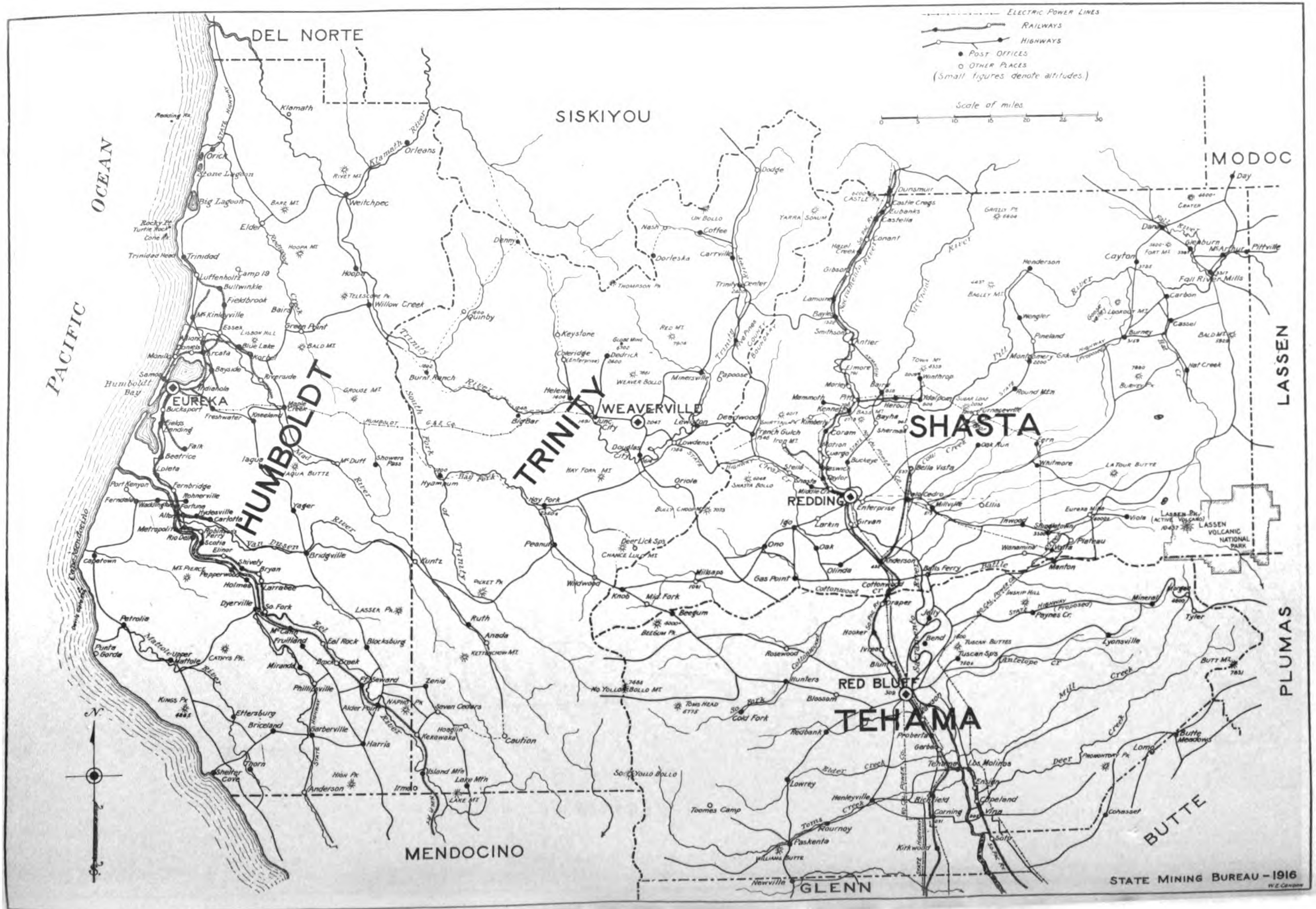
Issued by the

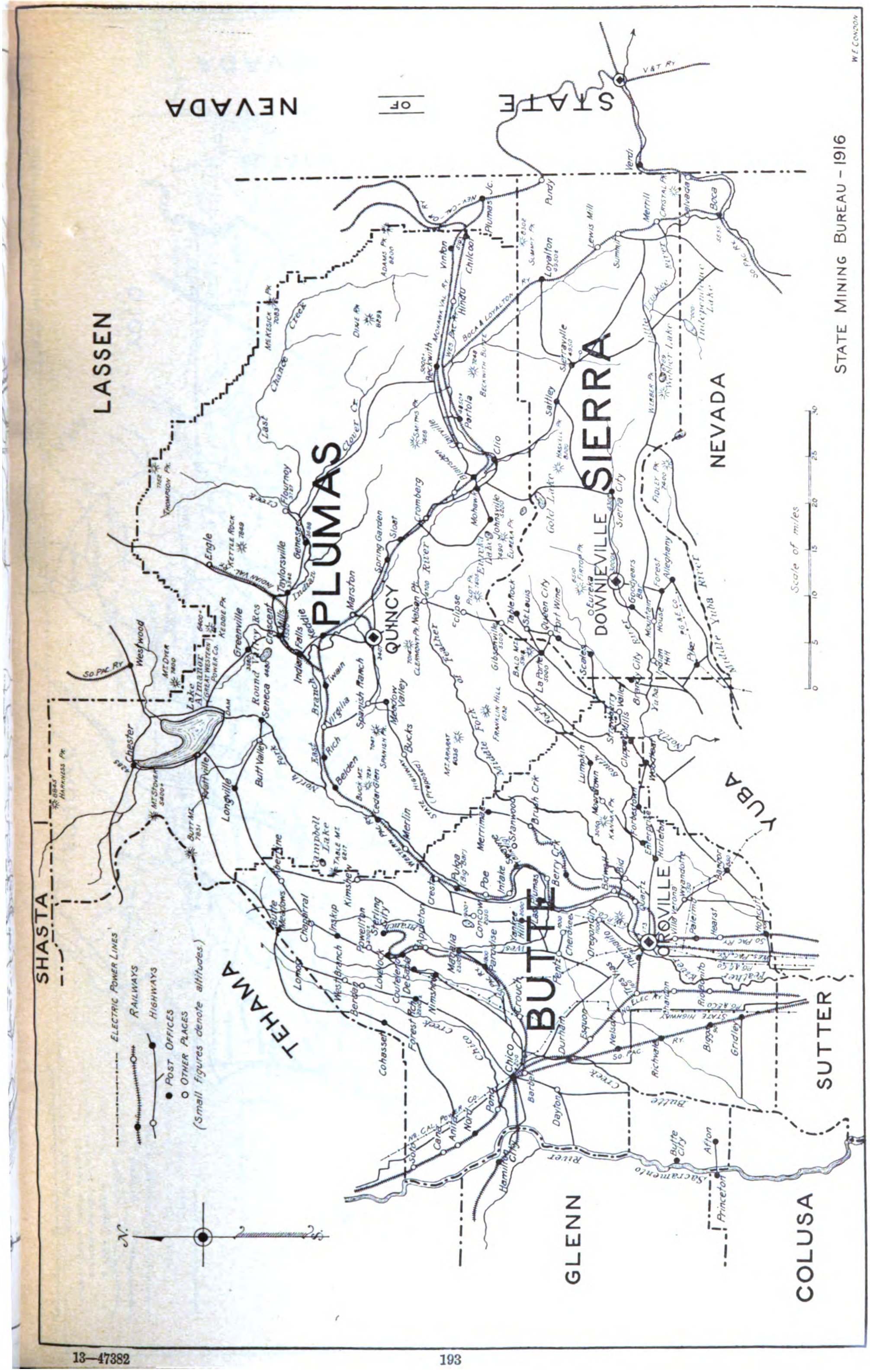
CALIFORNIA STATE MINING BUREAU

FLETCHER HAMILTON
State Mineralogist


STATE OF OREGON
SISKIYOU
DEL NORTE
HUMBOLDT
TRINITY
SHASTA
MODOC
PACIFIC
OCEAN
CRESCENT CITY
YREKA
Smith River
Lake Earl
Wakefield
Gasquet
South Fork
Patrick Cr. Sta
Monumental
Requa
Copper
Hutton
Eilleen
Preston Pk
Happy Camp
Nolton
Seiad Valley
Hamburg
Horse Creek
Oak Bar
Walker
Gottville
Scotts Bar
Henley
Hornbrook
Zuleka
Hilts
Cole
Copco
Fall Creek
Klamath Sps
Beswick
Bogus
Thrall
Ager
Snowdon
Croy
Frenchtown
Hawkinsville
Montague
Little Shasta
Roselawn
Grenada
Fort Jones
Oro Fino
Mugginsville
Greenview
Etna Mills
Gazelle
Edgewood
Weed
Coggins
Igerna
Mayten
Hoey
DeLaney
Geagan
Evans
Mt. Shasta
Upton
Deetz
Sisson
Azalea
Cantara
Shasta Sps
Upper Soda Sps
Castle Pk
Dunsmuir
Mott
Big Cañon
Signal Butte
McCloud
Snowden
Sawyers Bar
Rollin
Blackbear
Forks of Salmon
Somesbar
Gilta
Yocumville
Cecilville
Callahan
French Bar
Scott Mt
Un Bollo
Thompson Pk
Tanner Pk
China Mt
Marble Mt
Pineland
Morrison
Black Crater
Dairy
Erickson
Grass Lake
Penoyar
Bray
Kegg
Jerome
Mt. Hebron
Mt. Doel
Somerset
May
Ruby
Picard
Dorris
Brownell
Bradnack
Little Klamath Lake
Rhett Lake
Mt. Dome
Dome Mt
Tecnor
Glass Mt
Crystal Lake
Mt. Gavis
Slagger Creek
Crater
Bear Mt
Bartle
Glazier
Algomah
Swobe
Fall River
Klamath River
Salmon River
Scott River
Shasta River
Sacramento
McCloud River
Willow Cr
Trout Creek
Blue Creek
U Ko Nam Creek
County Boundary
State Highway
Electric Power Lines
Railways
Highways
Post Offices
Other Places
(Small figures denote altitudes)
Scale of miles
STATE MINING BUREAU – 1916


STATE OF OREGON
STATE OF NEVADA
SISKIYOU
SHASTA
MODOC
LASSEN
PLUMAS
SIERRA
ALTURAS
SUSANVILLE
Goose Lake
Upper Lake
Middle Lake
Honey Lake
Eagle Lake
Rhett Lake
Clear Lake
New Pine Creek
Fairport
Willow Ranch
Ft. Bidwell
Davis Creek
Lake City
Cedarville
Eagleville
Surprise
Mattes
Paola
Martin
Bayleys
Likely
Ivy
Steeleswamp
Triangle
Cornell
Straw
Stobie
Canby
Happy Camp
Pitt River
Day
Lookout
Adin
Bieber
Pittville
Fall River Mills
Moll Ranch
Madeline
Hayden Hill
Prockmans
Red Rock
Glade
Termo
Ravendale
Dixie
Dixie Valley
Modelin
Champs
Poison Lake
Crater Lake
Butte Lake
Snag Lake
Juniper Lake
Silver Lake
Merrillvile
Halls
Shumway
Horse Lake
Horselake
Antelope
Karlo
Secret
Waverly
Spanish Creek
Roop
Murray
Westwood Jc.
Wheaton
Goumez
Bunnel
Fredonia
Facht
Coppervale
Westwood
Leavitt
Johnstonville
Clinton
Standish
Litchfield
Hot Sp's
Wendel
Amedee
Dewitt
Edgemont
Lassen
Buntingville
Clark
Milford
Stacy
Italy
Calneva
Rayl (Liegan)
Doyle
Omira
Constantia
Red Canyon
Scotts
Camero
Chat
Chilcoot
Plumas Jc.
Railways
Highways
Post Offices
Other Places
(Small figures denote altitudes)
Scale of miles.
0 5 10 15 20 25 30
N.
State Mining Bureau – 1916
W.E. Condon


ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
0 5 10 15 20 25 30
DEL NORTE
SISKIYOU
MODOC
LASSEN
PLUMAS
BUTTE
GLENN
MENDOCINO
HUMBOLDT
TRINITY
SHASTA
TEHAMA
PACIFIC
OCEAN
EUREKA
WEAVERVILLE
REDDING
RED BLUFF
LASSEN VOLCANIC NATIONAL PARK
Humboldt Bay
STATE MINING BUREAU - 1916


LASSEN
SHASTA
TEHAMA
PLUMAS
BUTTE
SIERRA
NEVADA
YUBA
SUTTER
GLENN
COLUSA
STATE OF NEVADA
QUINCY
DOWNIEVILLE
OROVILLE
STATE MINING BUREAU - 1916
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes)
Scale of miles
W. E. CONDON

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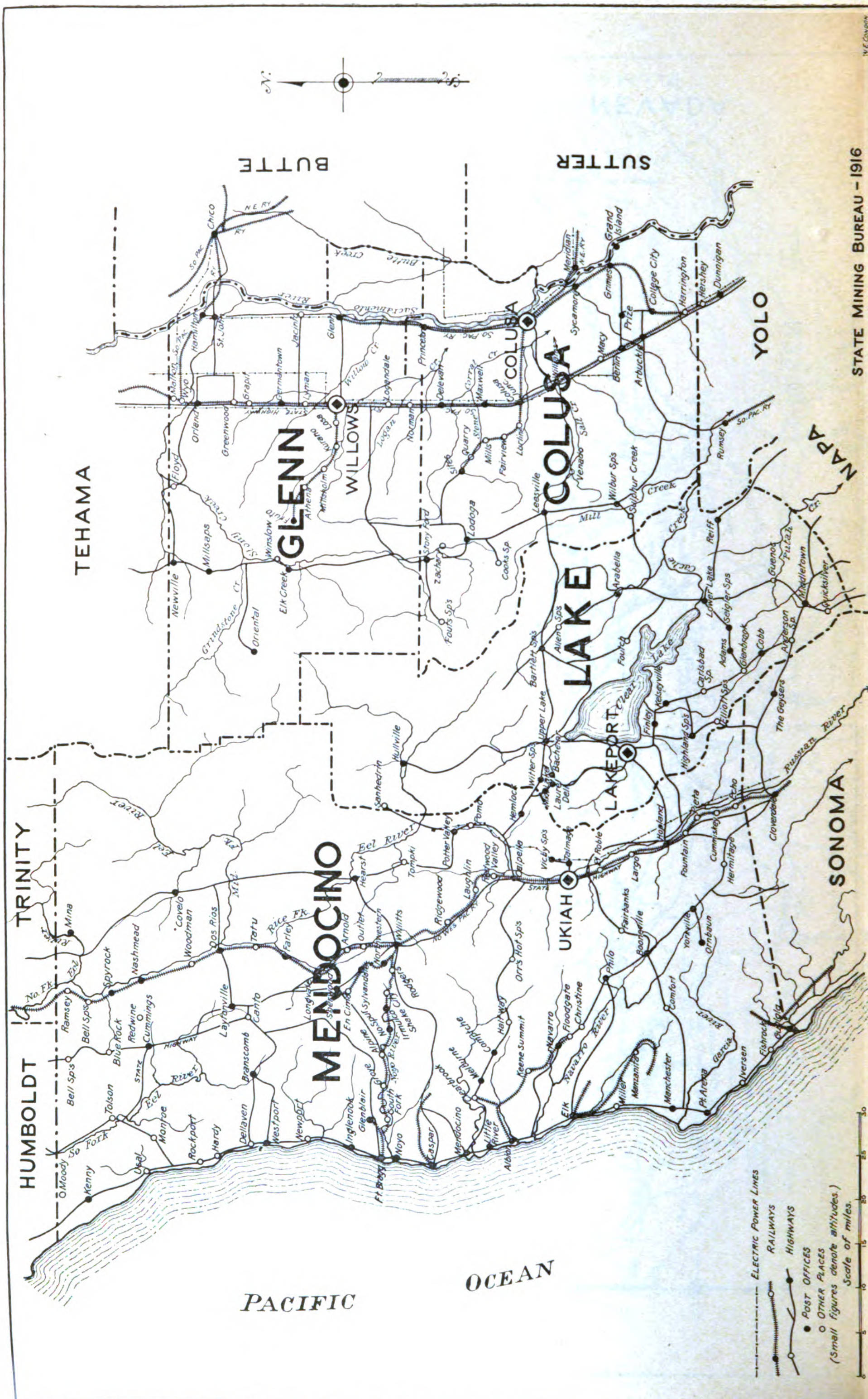
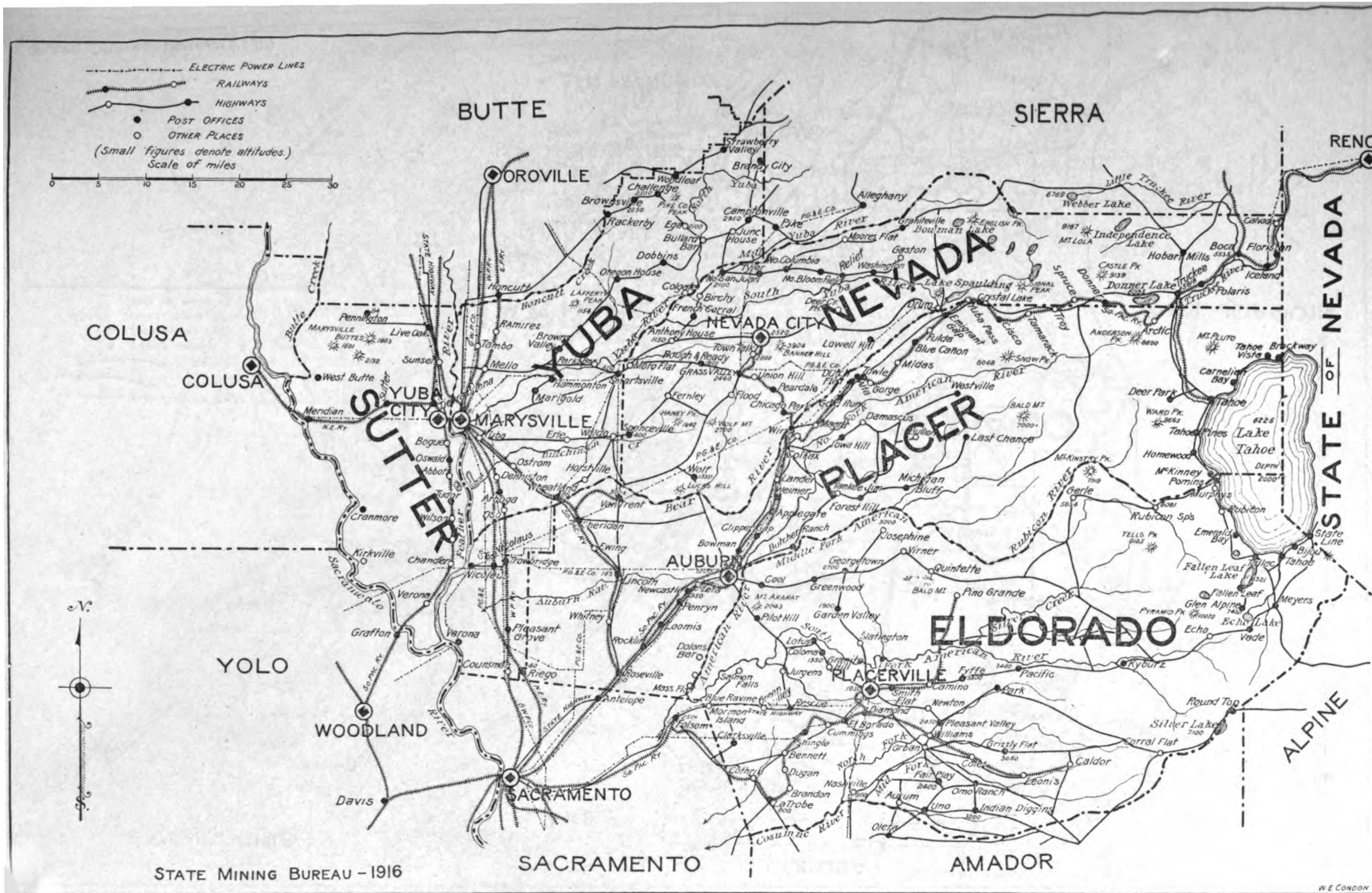
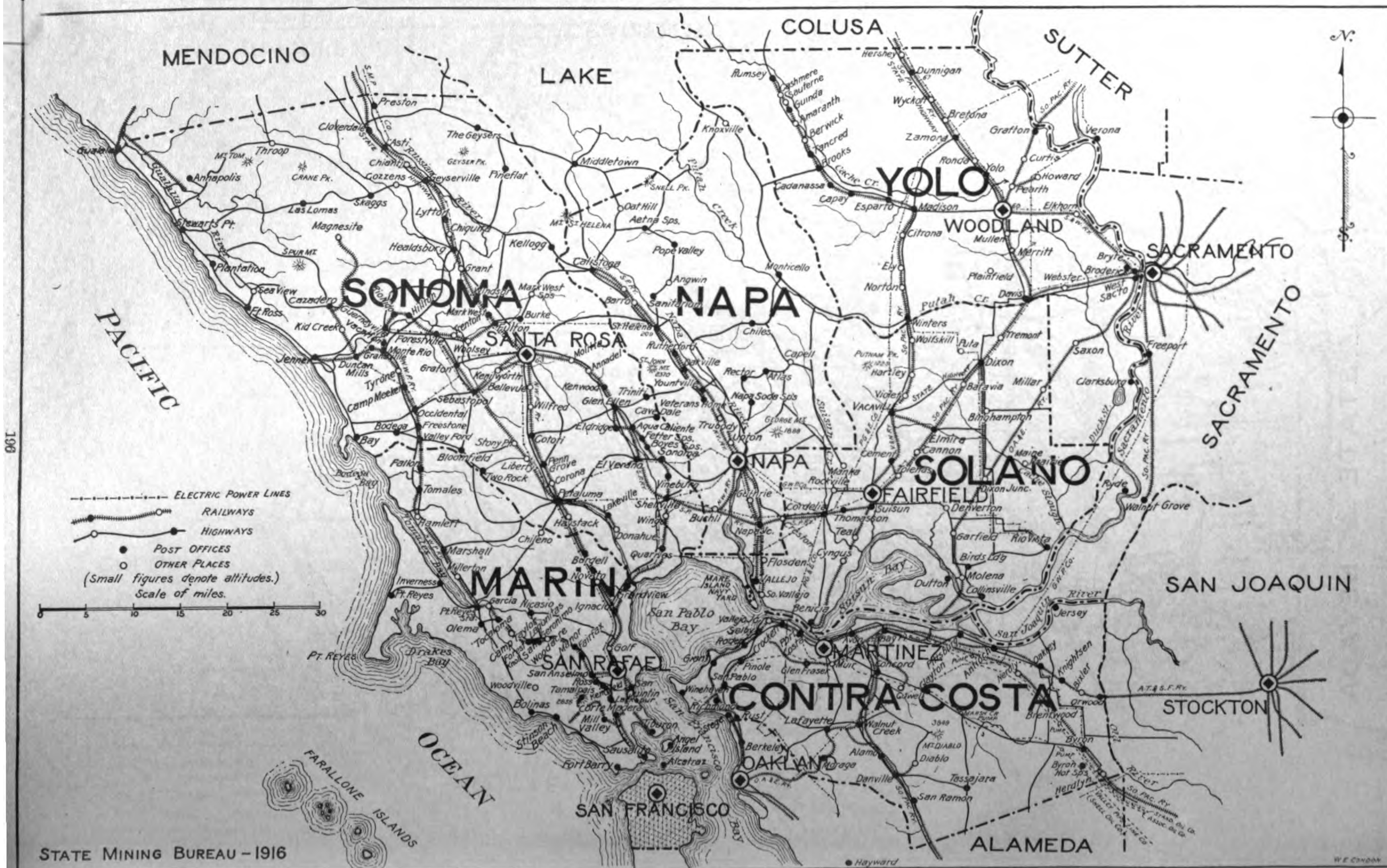
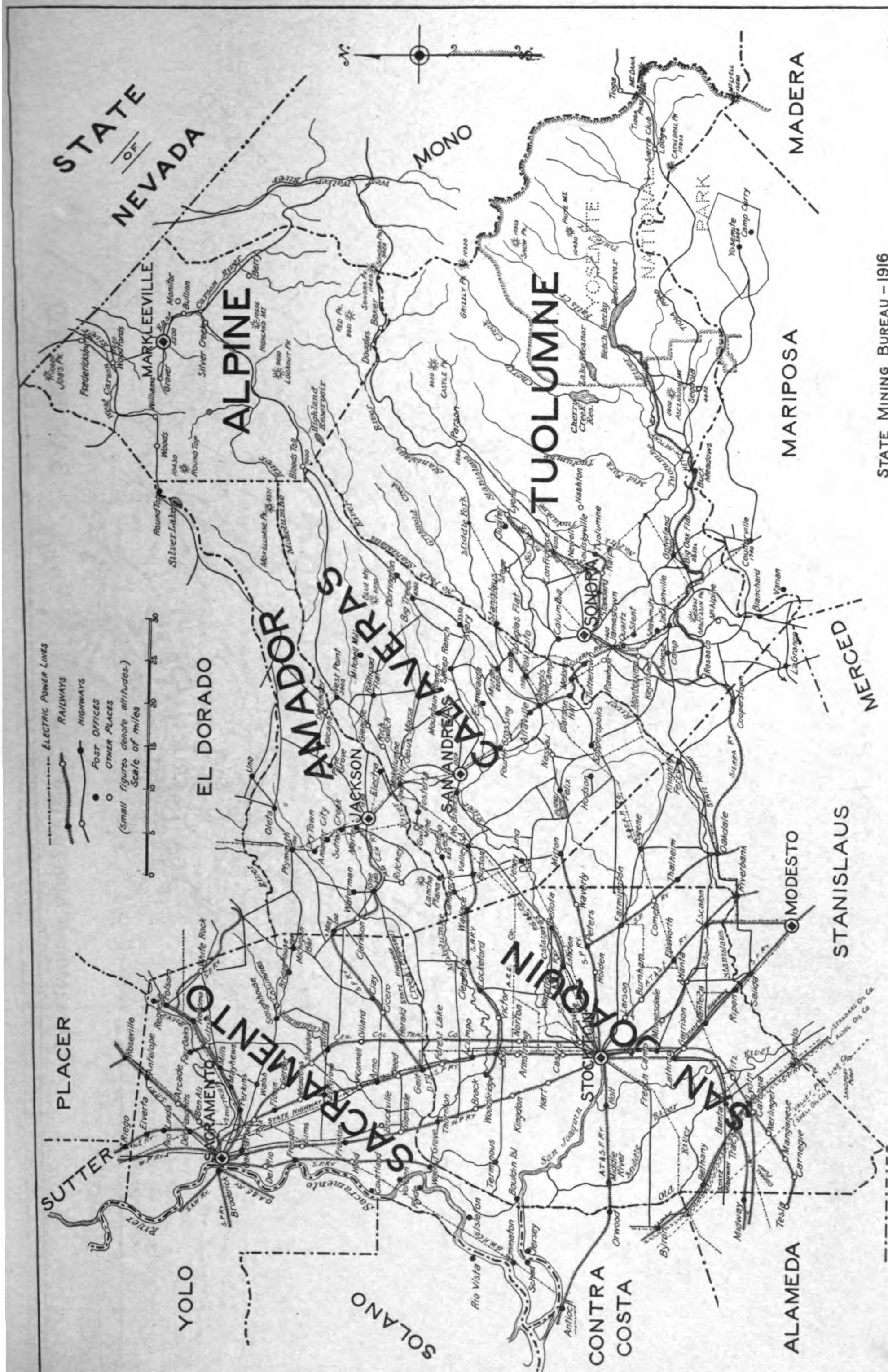
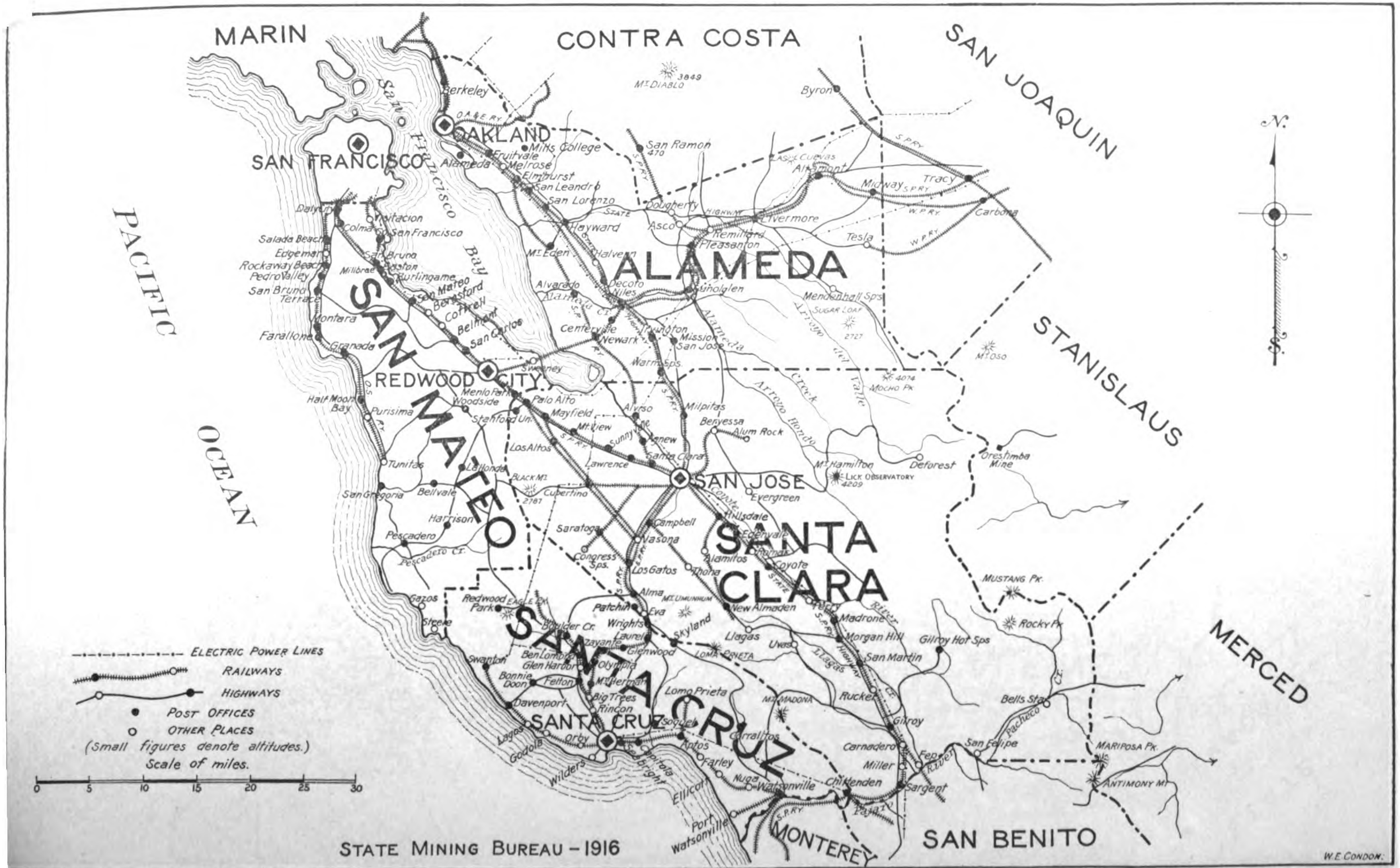

HUMBOLDT
TRINITY
TEHAMA
BUTTE
SUTTER
GLENN
COLUSA
MENDOCINO
LAKE
YOLO
NAPA
SONOMA
PACIFIC OCEAN
WILLOWS
COLUSA
LAKEPORT
UKIAH
N.
S.
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
STATE MINING BUREAU - 1916

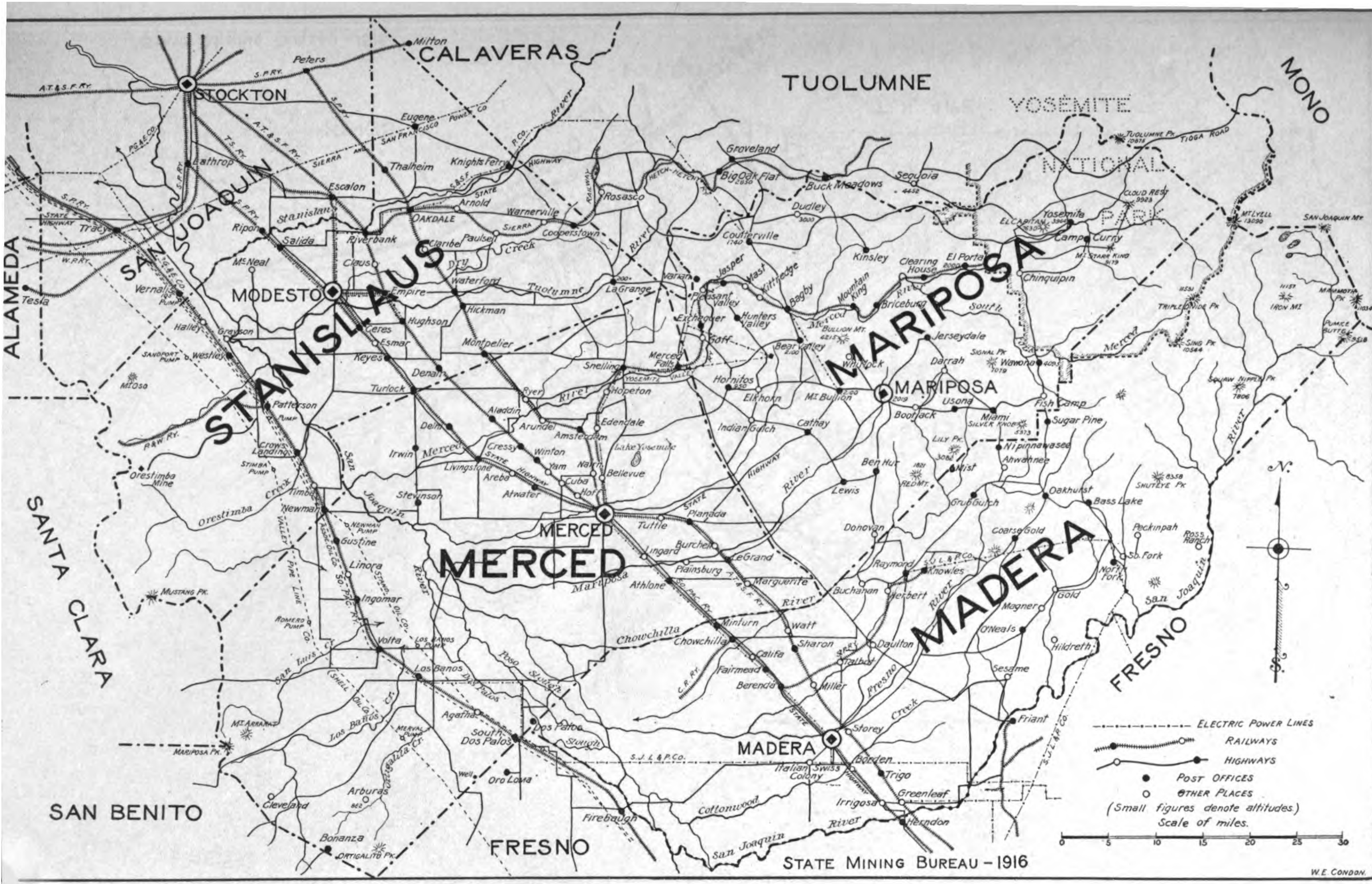

ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
0 5 10 15 20 25 30
BUTTE
SIERRA
COLUSA
YUBA
NEVADA
SUTTER
PLACER
YOLO
ELDORADO
SACRAMENTO
AMADOR
ALPINE
STATE OF NEVADA
RENO
OROVILLE
COLUSA
YUBA CITY
MARYSVILLE
NEVADA CITY
AUBURN
PLACERVILLE
WOODLAND
SACRAMENTO
Lake Tahoe
N.
STATE MINING BUREAU - 1916
W.E. CONDON

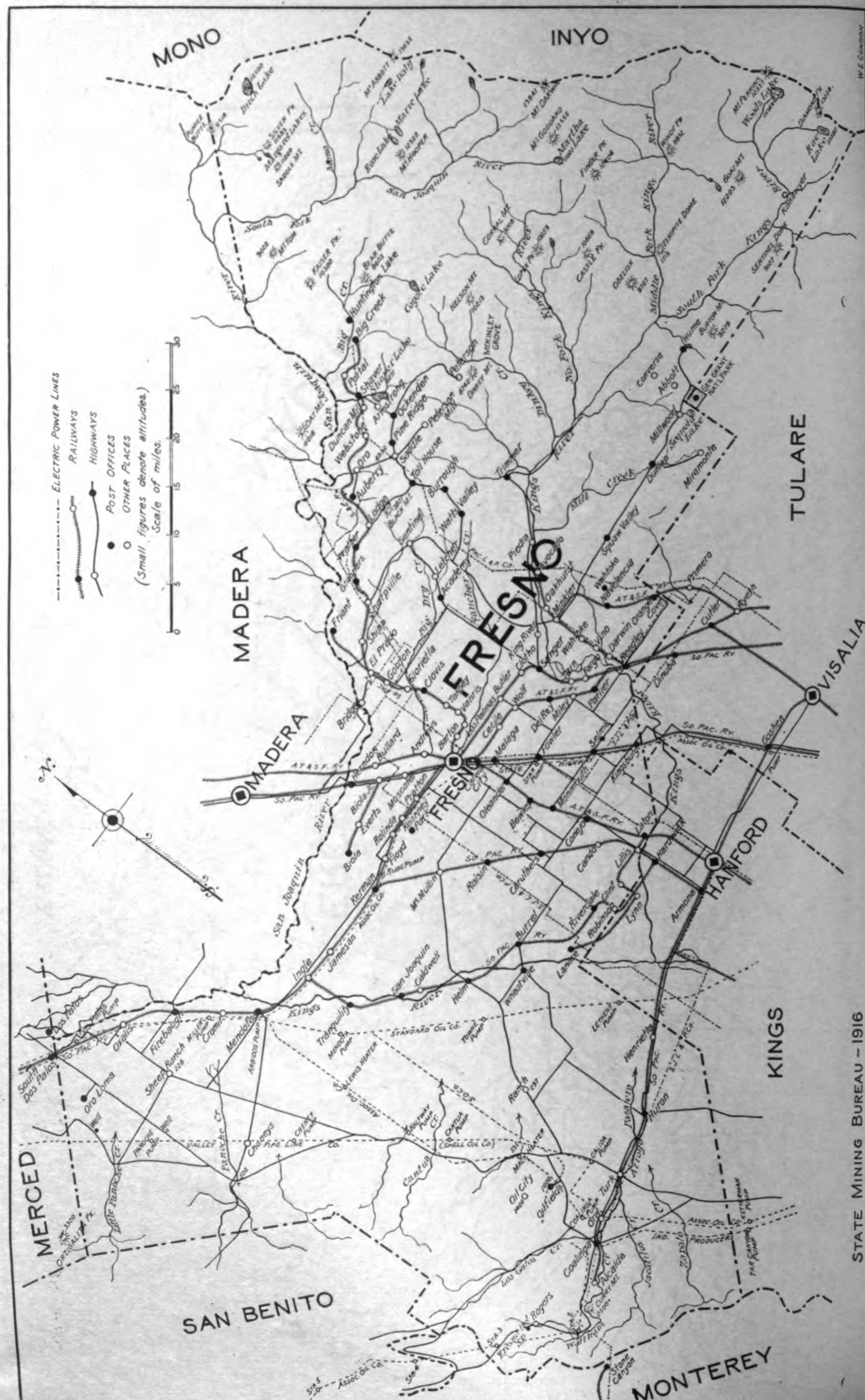

MENDOCINO
LAKE
COLUSA
SUTTER
YOLO
WOODLAND
SACRAMENTO
SACRAMENTO
SONOMA
SANTA ROSA
NAPA
NAPA
SOLANO
FAIRFIELD
MARIN
SAN RAFAEL
MARTINEZ
CONTRA COSTA
OAKLAND
SAN FRANCISCO
SAN JOAQUIN
STOCKTON
ALAMEDA
PACIFIC
OCEAN
FARALLONE ISLANDS
San Pablo Bay
Suisun Bay
Drakes Bay
Pt. Reyes
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0
5
10
15
20
25
30
STATE MINING BUREAU – 1916

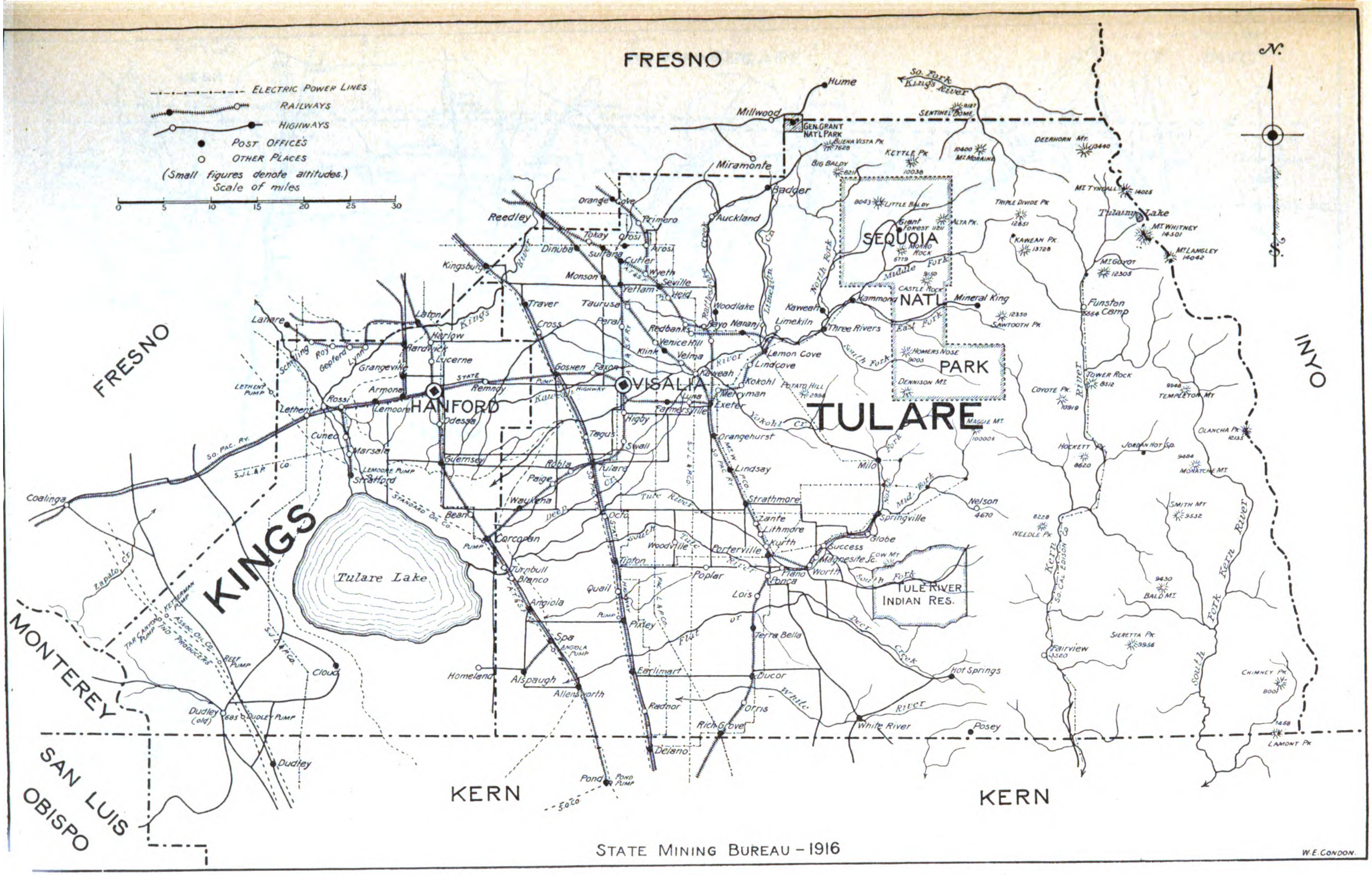

STATE OF NEVADA
MONO
ALPINE
MARKLEEVILLE
EL DORADO
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
TUOLUMNE
SONORA
YOSEMITE NATIONAL PARK
MARIPOSA
MADERA
MERCED
STANISLAUS
MODESTO
SAN JOAQUIN
STOCKTON
SACRAMENTO
PLACER
SUTTER
YOLO
SOLANO
CONTRA COSTA
ALAMEDA
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
0 5 10 15 20 25 30
STATE MINING BUREAU - 1916

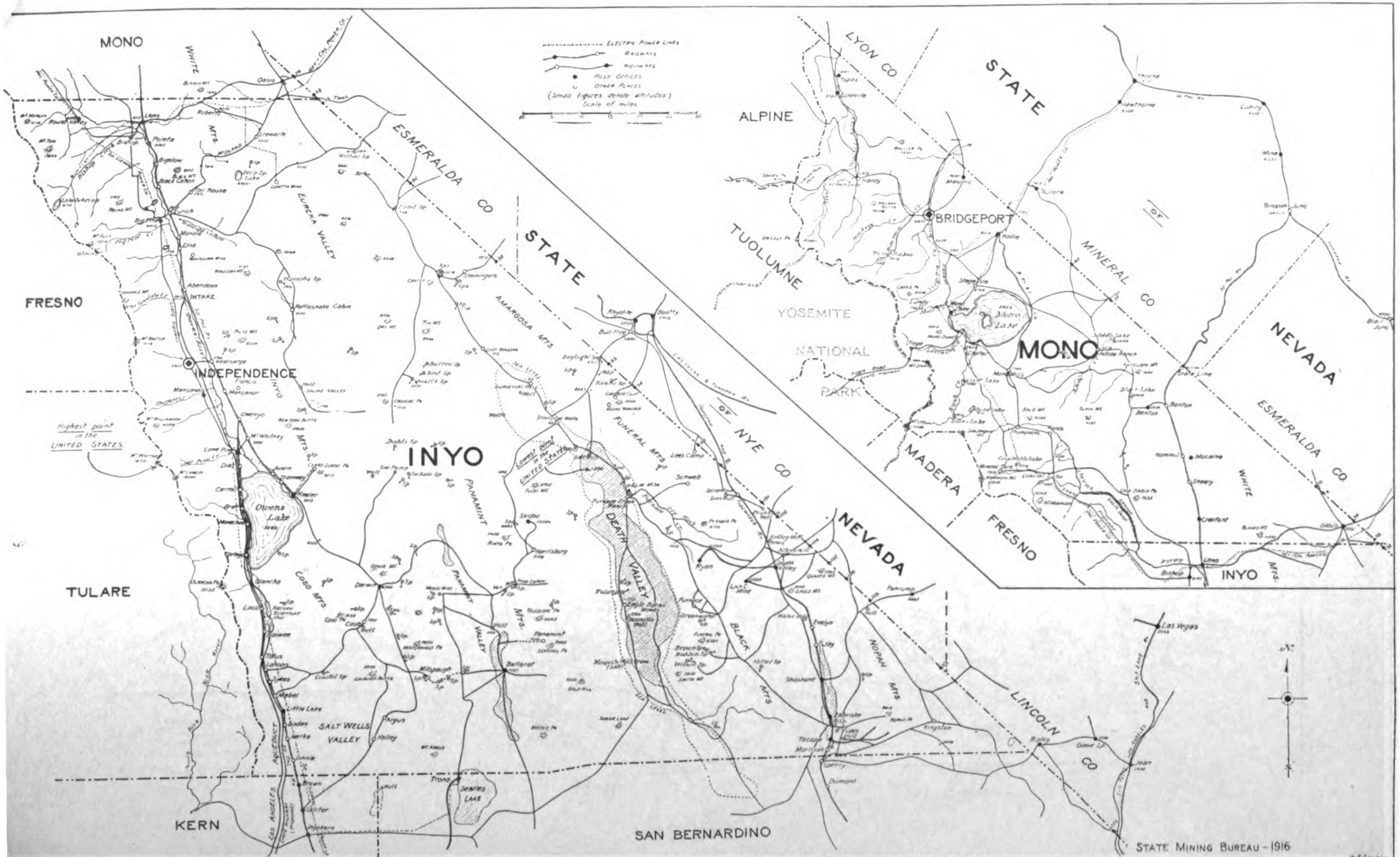


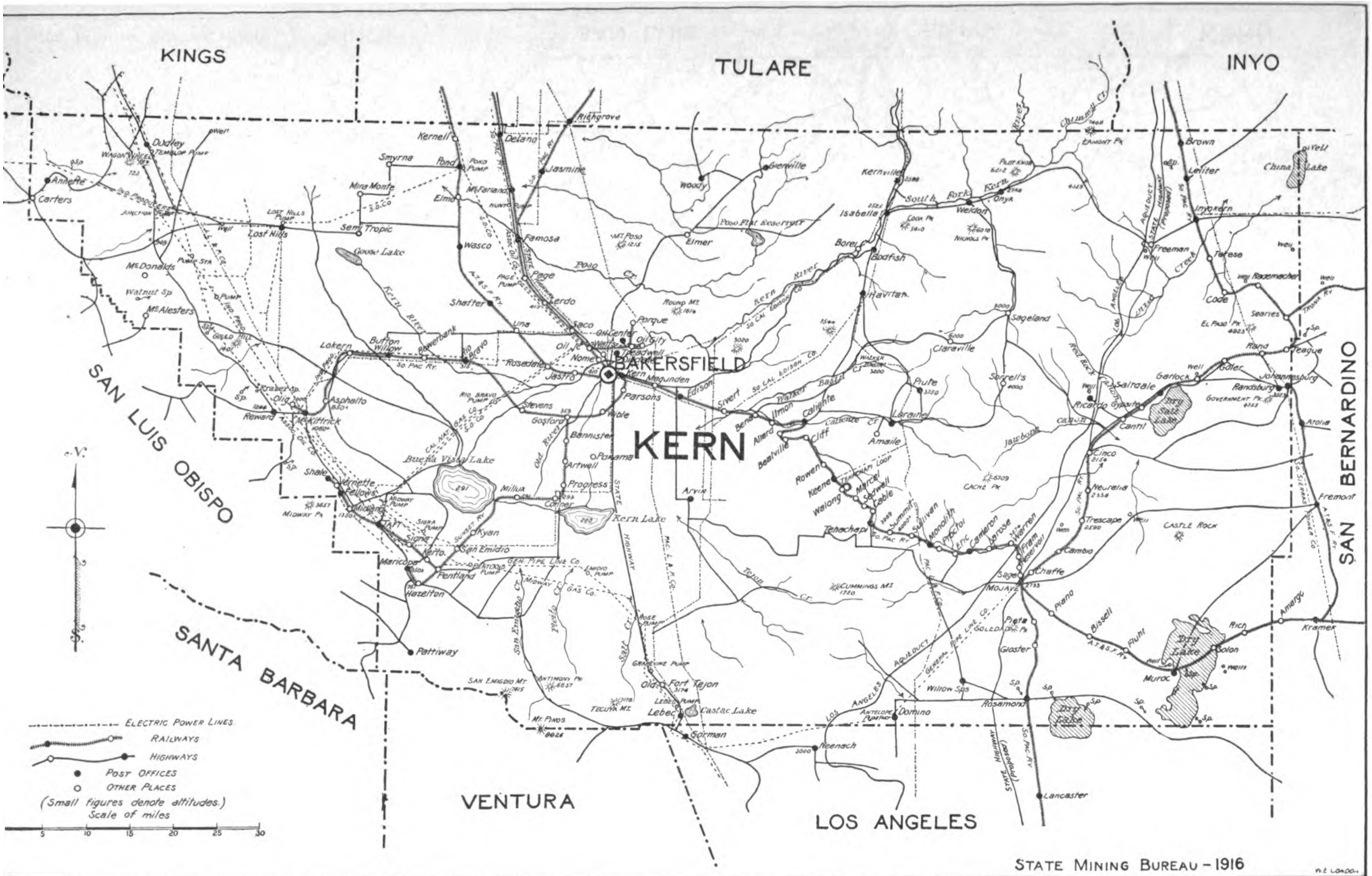
MARIN
CONTRA COSTA
SAN JOAQUIN
STANISLAUS
MERCED
ALAMEDA
SANTA CLARA
SAN MATEO
SANTA CRUZ
SAN BENITO
MONTEREY
SAN FRANCISCO
PACIFIC OCEAN
San Francisco Bay
OAKLAND
REDWOOD CITY
SAN JOSE
SANTA CRUZ
N.
S.
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0
5
10
15
20
25
30
STATE MINING BUREAU - 1916
W.E. CONDON.

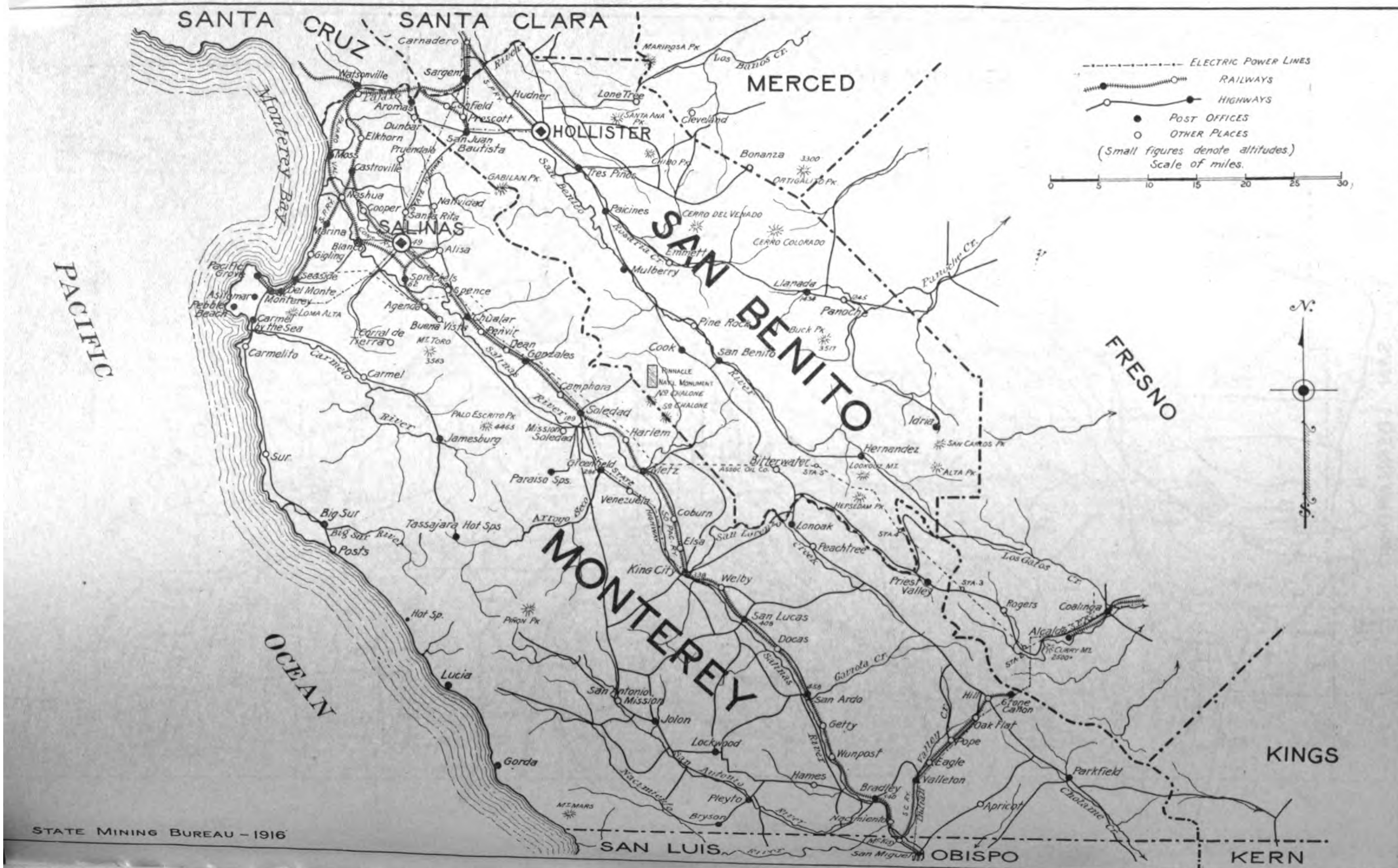

CALAVERAS
TUOLUMNE
MONO
YOSEMITE NATIONAL PARK
ALAMEDA
SAN JOAQUIN
STANISLAUS
MARIPOSA
MERCED
MADERA
SANTA CLARA
SAN BENITO
FRESNO
FRESNO
STOCKTON
MODESTO
MERCED
MARIPOSA
MADERA
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0 5 10 15 20 25 30
N.
STATE MINING BUREAU - 1916
W. E. CONDON.

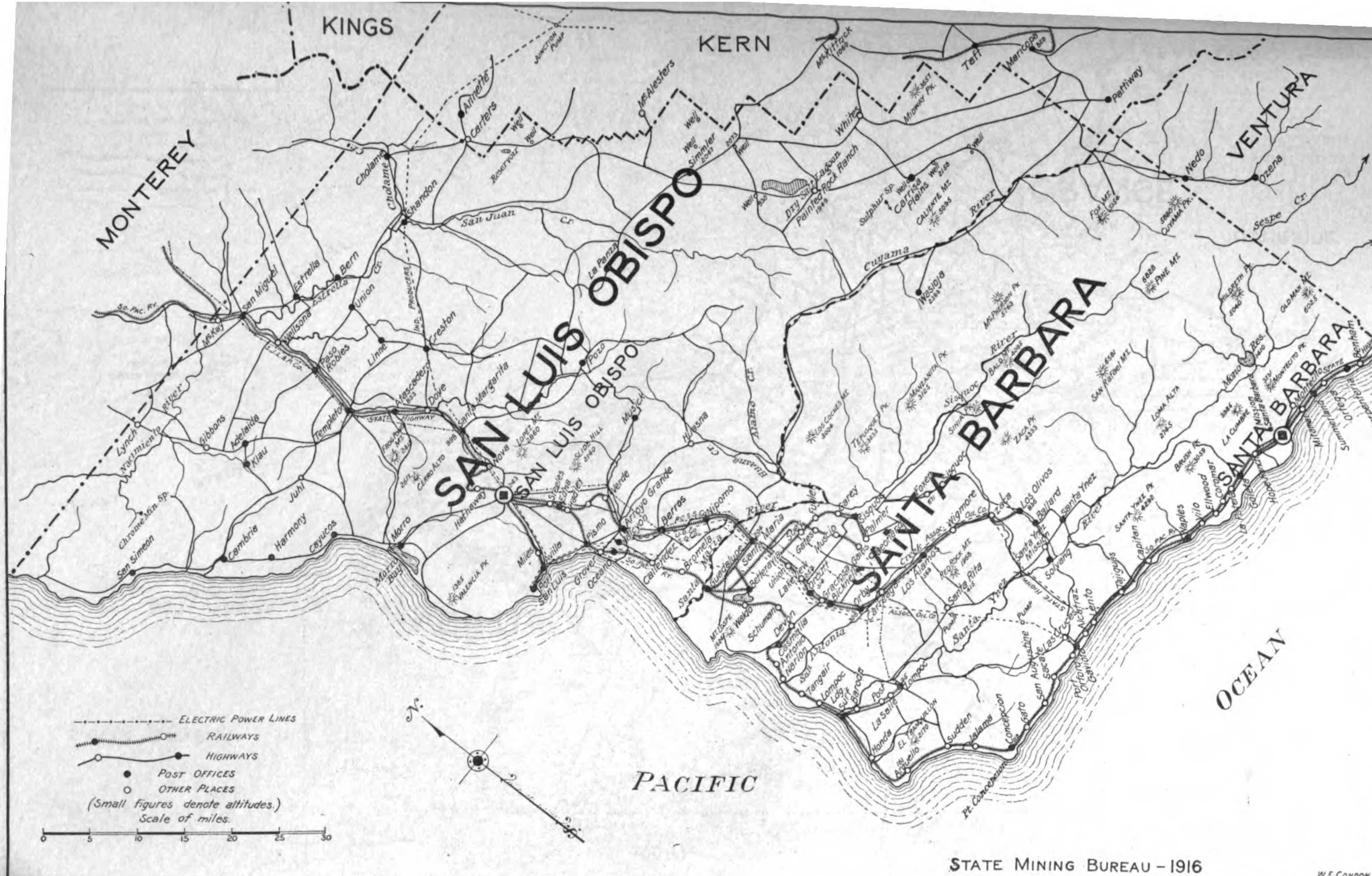

FRESNO
MADERA
MONO
INYO
TULARE
KINGS
MERCED
SAN BENITO
MONTEREY
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0 5 10 15 20 25 30
N.
STATE MINING BUREAU - 1916
VISALIA
HANFORD
Coalinga
Clovis
Sanger
Selma
Reedley
Kerman
San Joaquin River
Kings River


FRESNO
INYO
KINGS
TULARE
KERN
KERN
MONTEREY
SAN LUIS OBISPO
FRESNO
SEQUOIA NAT'L PARK
VISALIA
HANFORD
Tulare Lake
TULE RIVER INDIAN RES.
GEN. GRANT NAT'L PARK
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
0 5 10 15 20 25 30
N.
S.
STATE MINING BUREAU - 1916
W.E. CONDON.

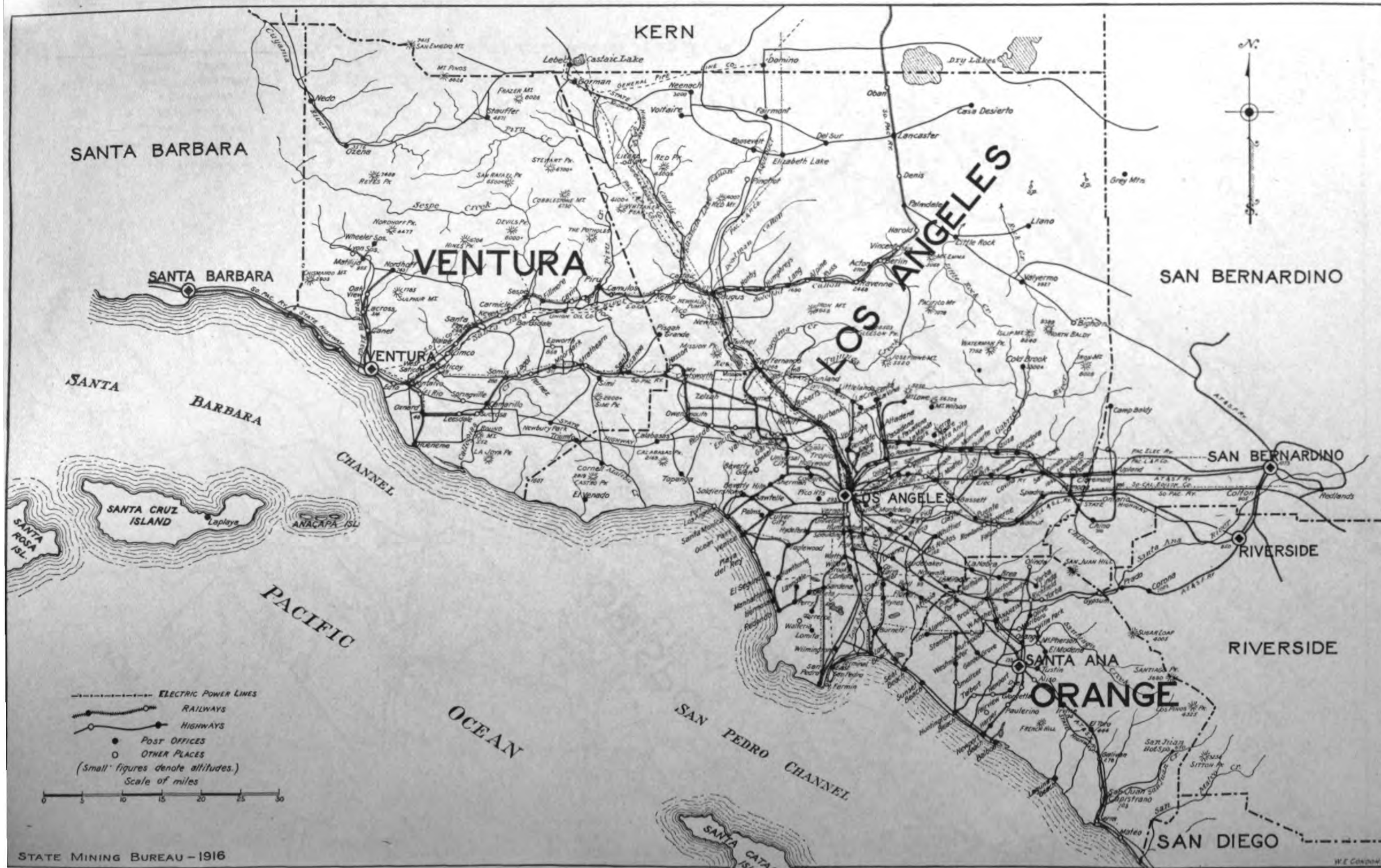

MONO
FRESNO
TULARE
KERN
INYO
INDEPENDENCE
Owens Lake
EUREKA VALLEY
SALT WELLS VALLEY
SAN BERNARDINO
ESMERALDA CO
STATE
NEVADA
NYE CO
OF
LINCOLN CO
DEATH VALLEY
AMARGOSA MTS
FUNERAL MTS
PANAMINT
COSO MTS
BLACK MTS
NOPAH MTS
Highest point in the UNITED STATES
Lowest point in the UNITED STATES
Las Vegas
Searles Lake
ALPINE
LYON CO
TUOLUMNE
YOSEMITE NATIONAL PARK
MADERA
BRIDGEPORT
MONO
Mono Lake
MINERAL CO
Electric Power Lines
Railways
Highways
Post Offices
Other Places
(Small figures denote altitudes)
Scale of miles
STATE MINING BUREAU - 1916

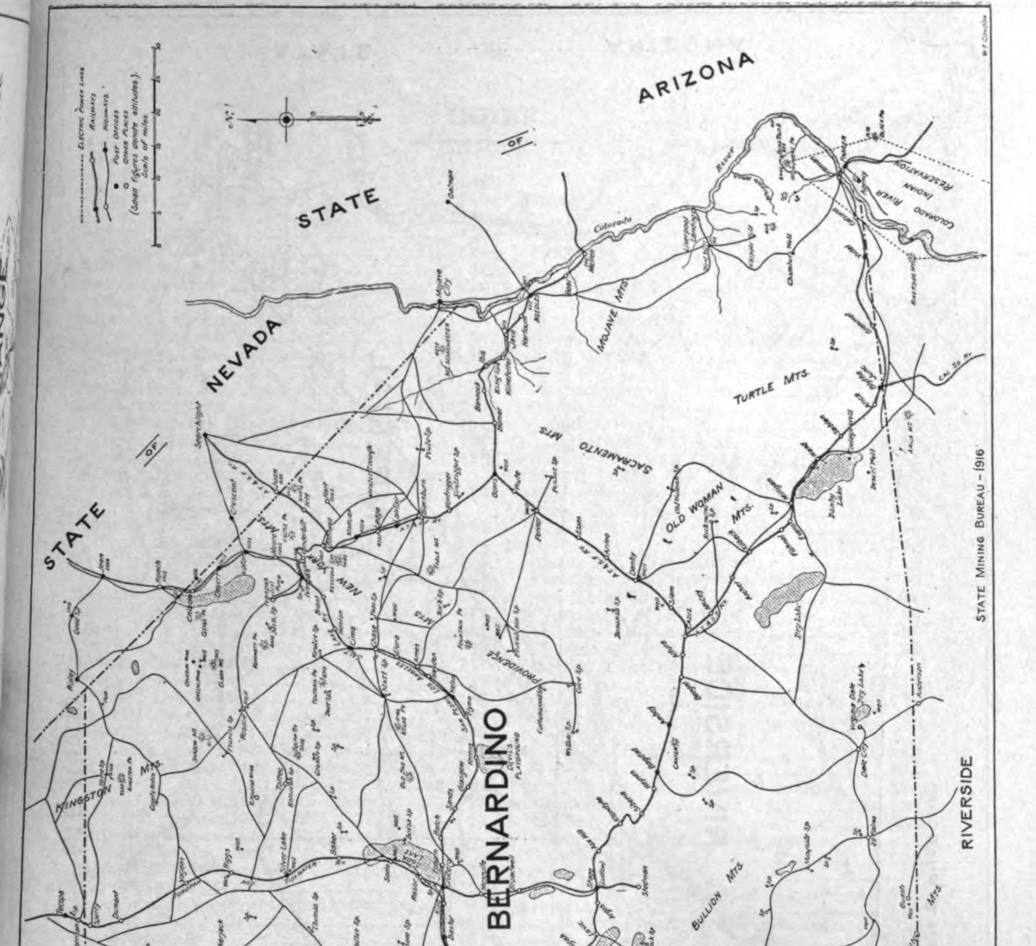

KINGS
TULARE
INYO
SAN BERNARDINO
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
KERN
BAKERSFIELD
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
5 10 15 20 25 30
STATE MINING BUREAU - 1916

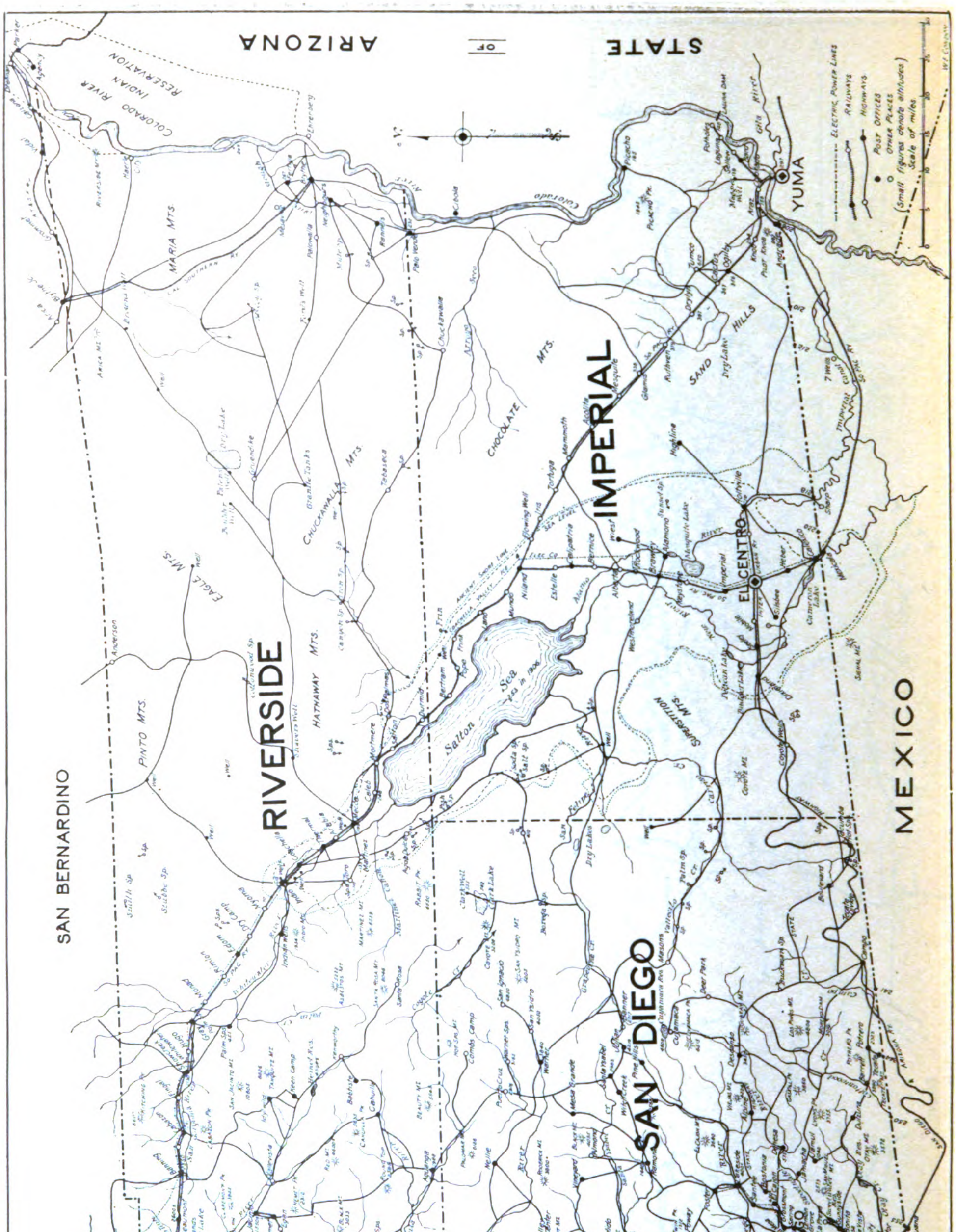

SANTA CRUZ
SANTA CLARA
MERCED
SAN BENITO
FRESNO
MONTEREY
KINGS
KERN
SAN LUIS OBISPO
PACIFIC
OCEAN
Monterey Bay
HOLLISTER
SALINAS
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0 5 10 15 20 25 30
N.
STATE MINING BUREAU - 1916



MONTEREY
KINGS
KERN
VENTURA
SAN LUIS OBISPO
SANTA BARBARA
PACIFIC
OCEAN
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles.
0 5 10 15 20 25 30
N.
STATE MINING BUREAU - 1916
W.E. CONDON.


KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
SANTA ANA
SANTA BARBARA CHANNEL
SANTA CRUZ ISLAND
SANTA ROSA ISL.
ANACAPA ISL.
SANTA CATALINA ISLAND
SAN PEDRO CHANNEL
PACIFIC OCEAN
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes.)
Scale of miles
0 5 10 15 20 25 30
STATE MINING BUREAU – 1916
W.E. CONDON


STATE OF NEVADA
STATE OF ARIZONA
SAN BERNARDINO
INYO
KERN
LOS ANGELES
RIVERSIDE
ORANGE
Electric Power Lines
Railways
Highways
Post Offices
Other Places
(Small figures denote altitudes)
Scale of miles
KINGSTON MTS.
PROVIDENCE MTS.
SACRAMENTO MTS
OLD WOMAN MTS.
TURTLE MTS.
MOJAVE MTS
BULLION MTS
SAN BERNARDINO MTS
SLATE RANGE
SOUTH END OF DEATH VALLEY
COLORADO RIVER INDIAN RESERVATION
Colorado River
SAN BERNARDINO
RIVERSIDE
STATE MINING BUREAU - 1916


STATE OF ARIZONA
COLORADO RIVER INDIAN RESERVATION
SAN BERNARDINO
RIVERSIDE
IMPERIAL
SAN DIEGO
ORANGE
MEXICO
PACIFIC OCEAN
YUMA
EL CENTRO
Salton Sea
CHOCOLATE MTS.
CHUCKAWALLA MTS.
HATHAWAY MTS.
PINTO MTS.
EAGLE MTS.
MARIA MTS.
SAND HILLS
SUPERSTITION MTS.
ELECTRIC POWER LINES
RAILWAYS
HIGHWAYS
POST OFFICES
OTHER PLACES
(Small figures denote altitudes)
Scale of miles
STATE MINING BUREAU – 1916

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